US Army Corps
of Engineers
Sacramento District

Construction Control Manual

Sampling & Testing Construction Materials

Reporting Test Results

CESPK PAM 415-1-2
15 Jun 1989

DEPARTMENT OF THE ARMY CESPK PAM 415-1-2
Sacramento District, Corps of Engineers
650 Capital Mall
CESPK-CO Sacramento, California 95814

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15 June 1989

Construction
CONSTRUCTION CONTROL MANUAL

FOREWORD

Quality and durability of the completed work is a direct reflection of the experience, pride, and judgment exercised by a responsible engineer at the project level. Satisfactory construction is obtained through emphasis on visual inspection and use of engineering judgment.

JACK A. Le CUYER
COL, EN
Commanding

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This PAM supersedes SPK PAM 415-1-2,
10 June 1983 and Change 1, 29 January 1988

PC/#CONSTMAN

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INDEX OF COMPLETED TEST FORMS

CHAPTER 1

CONSTRUCTION CONTROL MANUAL

l-l. General. This manual is applicable to contracts awarded on or after the date which appears on the cover of this manual. The 10 June 1983 manual applies to projects awarded before the above-referenced date.

l-2. Definitions.

a. Construction Control (CC) - Construction Control is a system involving the concurrent but separate efforts of the Contractor and the Government personnel to achieve the level of quality established by the project's contract documents.

b. Contractor Quality Control (QC) - Contractor's Quality Control is that part of the system by which the Contractor regulates, tests, and inspects his procedures, equipment, materials, and personnel so that the completed product will comply with the requirements of the project's contract documents.

c. Government Quality Assurance (QA) - Government Quality Assurance is that part of the system by which the Government (owner) verifies (1) that the Contractor's Quality Control system is performing properly and (2) that the final product complies with the project's contract documents.

d. Processed Aggregates - Processed aggregates are any materials the Contractor must process by washing, sorting, screening, crushing, etc. to produce an aggregate meeting the contract requirements.

l-3. Purpose. This manual prescribes procedures to be followed by Contractor and Government personnel assigned the responsibility of performing the Construction Control compliance. Procedures outlined in this manual are for testing materials including, but not limited to, materials used in fills, embankments, subgrades, base courses, flexible and rigid pavements, structural concrete, and masonry. Unless otherwise noted, this manual shall be used for all projects.

l-4. Resnonsibilitv. Comnilation. and Submittal of Test Results.

a. The Contractor shall be responsible for full compliance with these instructions in the performance of tests and the preparation, submittal, and maintenance of tests included herein and

listed in the contract specifications. The test results from QC and QA testing shall be compiled separately as outlined in this manual. The Resident Contracting Officer shall have overall responsibility to assure compliance by the Contractor, however, the Contractor shall be responsible for controlling quality and for compliance with contract requirements. The test results from both control and assurance tests shall be compiled as outlined in this manual. Copies of each test result shall be prepared with all necessary data recorded, documentation and computations completed. Distribution to the Corps of Engineers shall be as follows:

4 conies total:

2 copies to Resident Contracting Officer, Corps of Engineers

1 copy to District Engineer (through Resident Contracting Officer), Corps of Engineers

1 copy to Area Contracting Officer, Corps of Engineers

b. Distribution of the copies to the Resident Contracting Officer shall be made within 48 hours after sampling or initiating each test, except when the test duration requirements exceed 4% hours In the latter case, distribution shall be within 24 hours after completion of the test. Each test shall be started and completed without delay. Payment for materials placed, as well as for any subsequent construction dependent upon contract compliance of these materials, will not be authorized until test reports have been properly distributed. The Government will furnish sufficient copies of the test report forms, if blank master forms (to be reproduced as necessary by the Contractor) are not found in this manual. Request for resupply of forms will be the responsibility of the Contractor.

c. All test forms shall be accurately completed, and a test location plan shall be submitted when directed by the Resident Contracting officer. All test forms not accurately completed will be immediately returned to the Contractor for correction or completion, and no Quality Control tests will be accepted unless signed by the Laboratory Manager and Supervising Technician. The Materials Test Log (summarizing QC testing) shall be maintained at the Contractor's project office and will be divided into four parts for recording sample numbers of tests on (S) soils and processed aggregates, (B) bituminous materials and mixes, (C) Portland Cement concrete, and (0)

other types of material such as masonry, roofing material, etc. Each sample and test will be assigned a laboratory number at the time of arrival of the sample at the laboratory or beginning of the test. This number shall contain the last four digits of the contract number, followed by a letter designating the construction use of the material using the letter "S" for soils and processed aggregate, "B" for bituminous material, "C" for Portland Cement concrete, and "O" for other types of material and then followed by the sample number. For soil, processed aggregates, as well as bituminous materials and mixes, a second letter will be included to differentiate a test on a material from a bulk sample from a material obtained from a field density hole - use a letter "S" from bulk samples and a "D" from densities. Retests will be made for failed tests and assigned the same number as the original tests with a final letter to identify them as a retest. For example 0062-BD-132, 0062-BD-132A. In addition, a copy of the Materials Test Log shall be submitted with each monthly progress report for determining the Contractor's progress payment for materials placement represented by these tests.

1-5. Contractor's Quality Control (QC). The QC program is based, in part, on specific tests required for several items of work involved. The location and frequency of tests required depend on the manner in which the work is being performed and the uniformity and quality of the tests obtained. A minimum testing program for quality control testing is outlined in this manual. Additional testing may be required by the specifications for contracts when the minimum testing program is not considered to be adequate or applicable. Tests indicating noncompliance with the contract documents shall be reported immediately to the Resident Contracting Officer or the Resident Contracting Officer's representative, however, the Contractor's Quality Control representative will recommend steps to be taken to alleviate areas of noncompliant conditions. The Resident Contracting Officer or his representative reserves the right to designate the location and type of additional sampling and testing (to be performed at the Contractor's expense) to verify compliance if quality is inconsistent or questionable. References to standard test methods and testing procedures for sampling and testing of the material are given in each chapter of this manual, unless otherwise specified, and additional types of tests may be required by other areas of the contract documents. Periodic Quality Assurance tests shall be made by the Contracting Officer's representative to assure the Contractor's compliance with contract requirements and specifications.

1-6. Government Quality Assurance (QA). Unless otherwise specified, the frequency of QA testing will be determined by the Contracting Officer's representative. For all projects, the recommended minimum testing frequency will be at least two tests done concurrently with the first two QC tests and thereafter at a rate of one test for every 10 tests made by the Contractor.

1-7. Laboratory Facilities. The Contractor shall use only an established commercial laboratory approved by the Resident Contracting Officer. Laboratory facilities and personnel are to be in accordance with ASTM D 3740 (soils), ASTM C 1077 (concrete), and ASTM D 3666 (asphalt) as applicable. The Government reserves the right to make inspections of the Contractor's designated laboratory facilities, including test equipment and procedures. This is to ensure that all equipment is in proper working order, as well as correctly calibrated, and that specified test procedures are being performed by qualified personnel. The Government also reserves the right to conduct additional QA testing, using either its own equipment and facilities or the Contractor's. This additional QA testing shall be performed for all projects, as the Resident Contracting Officer deems necessary, to assure the Contractor's compliance with the contract documents.

1-8. Quality Control Plan. As soon as possible after the contract has been awarded and prior to commencement of any work, a Construction Quality Control Meeting shall be held. The purposes of this meeting will be to discuss quality control inspection requirements as well as the Contractor's Quality Control Plan designed to fulfill these requirements. To address the materials testing portion of the Quality Control Plan, the following shall be included with the Quality Control Plan using this manual for guidance:

a. The QC organization and its structure.

b. Proposed methods of performing inspections.

c. Established areas of responsibility.

d. Name and qualifications of each individual assigned a QC function. (Quality Control Representative, Laboratory Manager, Supervising Technician, and Technicians)

e. Description of how testing will be performed.

(1) Name of commercial laboratory (to be approved by the Resident Contracting Officer).

(2) Technicians employed by the laboratory to perform the test(s).

(3) Test methods to be used.

(4) Location and availability of test equipment.

f. Schedule of tests that will be performed (Materials Test Summary).

g. A date when the laboratory facility can be inspected (basis of laboratory approval).

No construction work shall commence until the Quality Control Plan has been approved by the Resident Contracting Officer, and any changes in the Quality Control Plan shall be submitted in writing for approval.

1-9. Special Test Reuuirements.

a. Soils and Processed Aaareaates. When more than 30% of the material is retained on a 3/4-inch sieve, laboratory maximum density shall be determined in accordance with EM 1110-2-1906, Appendix VI A (Utilizes a 12-inch mold). Field tests shall be determined in accordance with ASTM D 1556 using a 12-inch diameter ring and sand cone.

b. Lime. Asphalt, or Cement Stabilization. Shall be sampled and tested as stated in the contract documents.

c. Geotextiles. Shall be sampled and tested as stated in the contract documents.

CHAPTER 2

SOILS AND PROCESSED AGGREGATES

2-1. Scope.

a. This chapter prescribes methods and procedures for the Contractor Quality Control (QC) testing of materials used in all fills (except large dam embankments and cofferdams), backfills, embankments, subgrades, subbases, and base courses, unless otherwise noted hereinafter. Drainage materials are included in this scope and shall include all poorly-graded and well-graded processed aggregates used to remove moisture (or prevent the entrance of moisture) detrimental to final construction.

b. The types and frequencies of QC tests for large dam embankments and cofferdams are excluded from this manual and will be provided in the contract specifications for the respective projects.

c. The types and frequencies of QC tests for airfield and heliport construction are covered separately in this manual under Chapter 3: Airfield and Heliport Pavement - Soils and Processed Aggregates, or in the contract specifications for such projects.

2-2. Tests. Testing and reporting shall be performed in accordance with the American Society of Testing and Materials (ASTM) Standards as indicated below or as shown in Chapter 1 of this manual (latest editions at time of contract award, unless otherwise indicated).

a.	Samoling.	ASTM D 75	Sampling Aggregates.
b.	Sample Prenaration.	ASTM D 2217	Wet preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants (Method B).
c.	Gradation.	ASTM C 117	Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.
		ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates.

		ASTM D 422 Apparatus B	Particle-Size Analysis of Soils. (Only used when hydrometer analysis is specified)
		ASTM E 11	Wire-Cloth Sieves for Testing Purposes.
d.	Unit Weiaht.	ASTM C 29	Unit Weight and Voids in Aggregates.
e.	Svecific Gravity.	ASTM c 127	Specific Gravity and Absorption of Coarse Aggregate.
f.	Svecific Gravity.	ASTM D 854	Specific Gravity of Soils.
g.	Atterberg Limits.	ASTM D 4318 (Procedure B)	Liquid Limit, Plastic Limit and Plasticity Index of Soils.
h.	Moisture Content.	ASTM D 2216	Laboratory Determination of Moisture Content of Soil.
1.	Moisture - Density Relationship.	ASTM D 1557	Moisture-Density Relations of Soil and Soils Aggregate Mixture using 10-lb Rammer and 18-inch Drop (Methods B or D).
		EM 1110-2-1906 Appendix VI A (Utilizes a 12-inch mold)	Moisture-Density Relations of Soil (using a 12-inch diameter mold).
		ASTM D 4253*	Maximum Index Density of Soils Using a Vibratory Table.
j.	Field Densitv.	ASTM D 1556**	Density of Soil in Place by the Sand-Cone Method.

		ASTM D 2922***	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
		ASTM D 3017***	Moisture Content of Soil & Soil-Aggregate in place by Nuclear Methods.
k.	Wear Test.	ASTM C 131	Resistance to Abrasion of Small-Size Coarse Aggregate by Use of the Los Angeles Machine.
1.	Materials Classification.	ASTM D 2487	Classification of Soils for Engineering Purposes.

*Vibratory table shall be used for cohesionless materials for which a well-defined moisture-density relationship cannot be obtained using ASTM D 1557.

**The field density test shall be performed in accordance with the Standard Method of Test for Density of Soil in Place by the Sand-Cone Method, ASTM D 1556, except that in each test the weight of the disturbed sample representing the full depth of layer shall be not less than 10 pounds for fine-grained or sandy materials and 12 pounds for gravelly materials using a scale for weighing of sufficient capacity sensitive to .01 pounds. All field density samples shall be oven-dried in accordance with ASTM D 1556 and D 2216.

***The use of Nuclear Methods for determining field densities and moisture contents shall be limited to drainage materials and base course materials as outlined by Table 2-1, paragraph C-l.

2-3. Sampling and Testina of Fill. Backfill. Embankment, Drainaae. Subarade. Subbase, and Base Course Materials. This sampling and testing shall be in accordance with the standard procedures referred to in this manual. The minimum number of QC tests to be performed shall be as indicated in Table 2-l.

Table 2-l. Type of Tests and Frequency

A. BACKFILL AND EMBANKMENT TEST	FREQUENCY
1. Field Density w/Moisture Content.	1. Two per lift for each increment or fraction of 2000 s.y. placed during each 8-hour shift.
2. Gradation w/Atterberg Limits (from Compacted Material)*	2. One per 5 field densities.
3. Moisture-Density Relationships w/Gradation, Atterberg Limits, Specific Gravity, and Classification (from Bulk Sample).	3. One per 5 field densities (with not less than one per type of material) for the first 25 field density tests. Thereafter, one additional test for each change in material.

B. SUBGRADE AND SUBBASE TEST	FREQUENCY
1. Field Density w/Moisture Content	1. Two per lift for each increment or fraction of 1000 s.y. placed during each 8-hour shift.
2. Gradation w/Atterberg Limits (from Compacted Material)*	2. Two per five field densities.
3. Moisture-Density Relationship w/Gradation, Atterberg Limits, Specific Gravity and Classification (from Bulk Sample)	3. One per 5 field densities (with not less than one per type of material) for the first 25 field density tests. Thereafter, one additional test for each change in material.

C. BASE COURSE AND DRAINAGE MATERIAL	
TEST	**FREQUENCY**
1. Field Density w/Moisture.	1. Two per lift for each increment or fraction of 1000 s.y. placed during each 8-hour shift. First 5 testsduring initial construction of each base course or drainage material shall be determined by ASTM D 1556 and by ASTM D 2992 for correlation of sand cone and nuclear methods. Thereafter, every 5th nuclear test method shall be verified by sand cone method. If verification testing does not show adequate correlation as determined by the Contracting Officer, all tests shall be performed in accordance with ASTM D 1556. However, the Contractor may, at his option, perform all field density tests in accordance with ASTM D 1556.
2. Gradation and Atterberg Limits (From Compacted Material)*	2. Two per five field density tests.
3. Moisture-Density Relationship w/Gradation, Atterberg Limits, Specific Gravity, and Classification (from Bulk Sample).	3. One per 5 field density tests (with not less than one per type of material) for the first 25 field density tests. Thereafter, one additional test for each change in material.

4. Crushed Faces, L.A. Abrasion, and Smoothness	Frequency to be in accordance with contract specifications.

D. BACKFILL FOR CULVERT TRENCHES, WALLS, CULVERTS, & BUILDING PERIMETERS	
TEST	**FREQUENCY**
1. Field Density w/Moisture	la. Culverts and Utility Trenches: One per lift for each increment or fraction of 500 lineal feet of backfill. lb. Walls and Building Perimeters: One per lift for each increment or fraction of 200 lineal feet of backfill.
2. Lab Moisture Density Relations w/Atterberg Limits, Gradation, Specific Gravity, and Classification (from bulk sample).	2. One per 5 field density tests (with not less than one per type of material) for the first 25 field density tests. Thereafter, one additional test each time there is a change in material.

*Compacted material sample taken adjacent to field density test site.

NOTE: For subbase and base courses, measure thickness of lift concurrently with field density test and record on test form.

In addition to the minimum testing program listed above, representative samples of subgrade, subbase, base, and all other construction materials (including on-site materials) shall be collected (prior to compaction) by the Contractor and submitted to the Government for testing. Samples shall be taken under the direction of the Contractor's Quality Control representative. Bag samples for this purpose shall be shipped within 24 hours by the Contractor at the Contractor's expense to the Sacramento District Laboratory, Corps of Engineers, 2021 Jefferson Boulevard, West Sacramento, California 95691. Weight of these samples shall be a

minimum of 100 pounds for material containing less than 10% plus No. 4 material, 150 pounds for material containing more than 10% plus No. 4 material, or 750 pounds for material containing more than 30% plus 3/4-inch material.

2-4. Comoilation of Test Data for Submittal of Test Results. The following six test results shall be submitted concurrently:

a. Moisture-Density Determinations, (Figure 2-l). This form is for use in determinins the optimum moisture and maximum unit weight (density of soils-and processed aggregates). The moisture-density curve shall be plotted based on a minimum of four compaction test specimens. The zero-air-voids curve shall also be plotted using the specific gravity test data from ASTM D 854 and ASTM C 127. Classification of sample shall be in accordance with ASTM D 2487, with the classification group name and group symbol clearly and accurately stated. The Resident Contracting Officer may require, at no additional cost to the Government, single-point checks of moisture-density relations (ASTM D 1557 dry of optimum moisture), if it is evident through Quality Assurance testing that the Quality Control testing is not being adequately controlled with respect to the precision requirements of ASTM D 1557, paragraph 9.

b. Field Density Test (Sand Cone Method). (Figure 2-2). This test form is used to determine the degree of compaction. This sheet can also be used for recording moisture content of fill in borrow material or as placed.

c. Field Density Test (Nuclear Method). (Figure 2-3). This test form is used to determine the degree of compaction when using the Nuclear Method.

d. Gradation Sheets, (Figures 2-4 and 2-5). These forms are used to record the results of gradation tests for all materials. Figure 2-4 shows a typical example in which gradation tests were performed in accordance with ASTM Standards C 136 and C 117. Results from these tests shall be tabulated as shown in Figure 2-4 and plotted as shown in Figure 2-5.

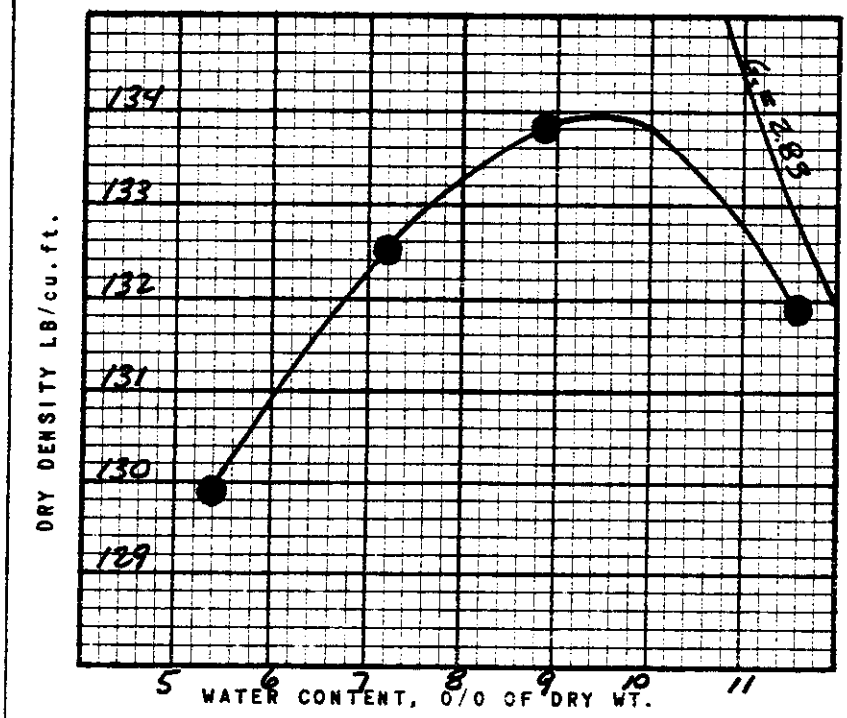
e. Atterberg Limits Determination, (Figure 2-6). This form is used to compute liquid limit, plastic limit, and plasticity index.

f. Specific Gravity Tests, (Figure 2-7). This form is used to compute specific gravity of soils, aggregate, and stone.

PROJECT SRO-MATHER AFB - ALTER. MECH. SYS.	CORPS OF ENGINEERS VALLEY ENG. LABORATORY COMPACTION-MOISTURE DENSITY DETERMINATIONS	DATE 23 OCT 87 SOURCE OF MATERIAL SELECT FILL MIX ALL CONST.
CONTRACT NO 87-C-0185		
TEST NO 0185-S-1		TEST METHOD ASTM D1557-78-D

DIA. OF MOLD (in.) 6	NUMBER OF LAYERS 5	NUMBER OF BLOWS PER LAYER 56	WEIGHT OF TAMPER 10 lbs
HEIGHT OF DROP (in) 18"	MAXIMUM PARTICLE SIZE 3/4"	HEIGHT OF SOIL SAMPLE (in) 4.586	HAND TAMPER ☒ MECHANICAL TAMPER ☐

A. WATER ADDED C.C. OR PERCENT	4%	6%	8%	10%	
B. MOLD NUMBER	1	1	1	1	
C. WT. OF WET SOIL + MOLD	44.73	45.11	45.39	45.50	
D. WT. OF MOLD	34.46	34.46	34.46	34.46	
E. WT. OF WET SOIL (C-D)	10.27	10.65	10.93	11.04	
F. VOL. OF SOIL SAMPLE (CU. FT.)	.0750	.0750	.0750	.0750	
G. $\frac{E}{F}$ = WET DENSITY LB/CU.FT.	136.9	142.0	145.7	147.2	
H. CONTAINER NO	55	56	57	58	
I. WT. OF WET SOIL + TARE	9.2	11.76	11.62	9.95	
J. WT. OF DRY SOIL + TARE	8.80	11.05	10.77	9.00	
K. WT. OF WATER (I-J)	.43	.71	.85	.95	
L. WT. OF TARE	.89	1.24	1.25	.83	
M. WT. OF DRY SOIL (J-L)	7.91	9.81	9.52	8.17	
N. $\frac{K}{M}$ WATER CONTENT %	5.4	7.2	8.9	11.6	
P. DRY UNIT WT. $\left(\frac{G}{100+N}\right)$ = LB/CU.FT.	129.9	132.5	133.8	131.9	



TEST RESULTS	
OPT. WATER CONTENT, 0/0	9.5
MAXIMUM DRY DENSITY, LB/CU.FT.	134.0

CLASSIFICATION OF SAMPLE WELL-GRADED GRAVEL WITH SILT & SAND

LIQUID AND PLASTIC LIMITS: LL. ____ PL. ____ PI. N/P

SYMBOL FROM PLASTIC CHART

REMARKS: GW-GM PER ASTM D2487

TESTED BY	CHECKED BY
J.D.	J.B.
SUBMITTED BY D. JONES	

FIGURE 2-1

CESPK PAM 415-1-2
1 Feb 89

CORPS OF ENGINEERS

VALLEY ENG. LABORATORY

FIELD DENSITY

PROJECT: SRO - MATHER AFB - ALTER MECHANICAL SYSTEMS
DATE: 30 OCT 87
FEATURE: ROAD SUBBASE (SELECT FILL)
SAMPLE TAKEN: 2ND LIFT
FROM: STA 2+70 TO: STA 3+00
CONTRACT NO.: 87-C-0185
ELEVATION TOP OF SAMPLE: 107.2' (FSG - 6")
LOCATION: 3RD STREET AT MAIN - MATHER AFB
DEPTH TO SAMPLE: TOP 0 BOTTOM 6"
SOURCE OF MATERIAL: IMPORT FROM MIX ALL CONST. (SACTO.)
NO. ROLLER PASSES: 6
DESCRIPTION: GW-GM WELL-GRADED GRAVEL W/ SILT & SAND
DENSITY NO.: 0185-S-1
TESTED BY: J. BOOTH

GROUND SURFACE CALIBRATION

A. CONTAINER NUMBER: 1
B. WT. INITIAL CONTAINER + SAND: 29.71 LBS
C. WT. AFTER CONTAINER + SAND: 26.50 LBS
D. WT. SAND (B - C) USE FOR K.: 3.21 LBS

CALIBRATION OF DENSITY SAND

1. WT. OF SAND + TARE: 21.36 LBS
2. WT. OF TARE: 14.46 LBS
3. WT. OF SAND: 6.90 LBS
4. VOL. OF CONTAINER: .0750 CU-FT
5. WT. CU-FT OF SAND (3/4): 92.0 LBS

DENSITY DETERMINATION

E. WET SAMPLE + CONTAINER: 15.22 LBS
F. WT. CONTAINER: .91 LBS
G. WT. WET SAMPLE (E. - F.): 14.31 LBS
H. SAND + CONTAINER START (FROM C.): 26.50 LBS
I. SAND + CONTAINER FINISH: 13.65 LBS
J. SAND IN HOLE + CONE (H. - I.): 12.85 LBS
K. SAND IN LOWER CONE + PLATE (D.): 3.21 LBS
L. SAND IN HOLE ONLY (J. - K.): 9.64 LBS
M. DENSITY OF SAND (5.): 92.0 LBS
N. VOLUME OF HOLE (L./M.): .1048 CU-FT
P. UNIT WET WT. SAMPLE (G./N.): 136.5 LB/CU-FT
R. UNIT DRY WT. SAMPLE (P/(100 + V)): 130.9 LB/CU-FT

COMPARISON OF FIELD DENSITY WITH MAXIMUM DENSITY

6. SEE LAB. COMPACTION TEST NO.: 0185-S-1
7. MAXIMUM DENSITY (LAB. COMP): 134.0 LB/CU-FT
8. DEGREE OF COMPACTION (R./T.): 97.7 %
9. COMPACTION REQUIRED: 95 %
10. OPTIMUM MOISTURE: 9.5 %
11. WT. RETAINED NO. 4: LBS %
12. WT. PASSING NO. 4: LBS %
13. TOTAL WT.: LBS

MOISTURE CONTENT

S. CONTAINER NUMBER: 46
T. WT. MOIST. SAMPLE + CONTAINER: 18.48 LBS
U. WT. DRY SAMPLE + CONTAINER: 17.89 LBS
V. WT. OF WATER (T. - U.): .59 LBS
W. WT. OF CONTAINER: 4.17 LBS
X. WT. OF DRY SAMPLE (U. - W.): 13.72 LBS
Y. PERCENT MOISTURE (V./X.): 4.3 %

ROCK CORRECTION
(Pycnometer or chart method optional)

AA. WT. IN AIR (SAT. SUR. DRY): GMS
BB. WT. IN WATER: GMS
CC. VOL. ROCK (AA. - BB.)/28.306: CU-FT
DD. CORRECTED WT. SAMPLE G - AA./453.6: LBS
EE. CORRECTED VOL. HOLE L./H. - CC: CU-FT
FF. CORRECTED UNIT WT. SAMPLE DD./EE.: LBS/CU-FT

COMPUTED BY: J. BOOTH
CHECKED BY: J. D.
SUBMITTED BY: D. JONES

SAMPLE

FIGURE 2-2

NUCLEAR FIELD DENSITY TEST WORKSHEET

PROJECT ALT. MECH. SYS. CONTRACT NO. 87-C-0185 DATE 30 Oct 87

LOCATION MATHER AFB, CA. CONTRACT DRAWING(S) C-1 TIME 7:30 A.M.

SOURCE IMPORT (MIXALL CO.) SPECIFICATION SECTION(S) 2241 ENGINEERING TECHNICIAN J. BOOTH

SUPERVISING TECHNICIAN D. JONES

TEST NO.	LOCATION & FEATURE	DEPTH OR ELEVATION	PROCTOR DENSITY PCF	O.M.C. %	DRY DENSITY PCF	MOISTURE CONTENT %	COMPACTION ACT. %	COMPACTION REQ. %	SAMPLE NO. AND SOIL TYPE (ASTM D 2487)
0185-S-1	℄ "C" ROAD STA 6+00 - BASE COURSE.	FG-3"	134.0	9.5	133.0	10.8	99	100	0185-S-1 WELL-GRADED GRAVEL W/ SILT & SAND (GW-GM)
0185-S-2	℄ "C" ROAD STA 6+50 - BASE COURSE.	FG-3"	134.0	9.5	137	10.1	100	100	"
0185-S-3	℄ "C" ROAD STA 7+00 - BASE COURSE.	FG-3"	134.0	9.5	133.9	9.6	100	100	"
0185-S-4	S.D. CROSSING "C" ROAD STA 7+10 - BASE CSE.	FG-3"	134.0	9.5	133.0	10.8	99	100	"
0185-S-5	ELEC. CROSSING "C" ROAD STA 7+40 - BASE CSE.	FG-3"	134.0	9.5	129.7	5.3	97	100	"
0185-S-6	℄ "D" ROAD STA 6+20 - BASE COURSE.	FG-3"	134.0	9.5	133.9	9.1	100	100	"
0185-S-7	℄ "D" ROAD STA 6+40 - BASE COURSE.	FG-3"	134.0	9.5	134.0	9.5	100	100	"

LABORATORY MANAGER _____

FIGURE 2-3

SIEVE ANALYSIS

Date 23 OCT 87

Project SRO - MATHER AFB #87-C-0185

Boring No. _____ Sample No. 0185-S-1

Total wt in grams of sample, W_s = 62.00 # | Wt in grams of material > No. 4 sieve =

Sieve Openings		U. S. Standard Sieve Size or Number	Weight Retained in grams	Percent Retained		Percent Finer by Weight
Inches	Millimeters			Partial	Total	
3.00		3-in.				
2.00		2-in.				100
1.50		1-1/2-in.	1.10 #	1.80	1.80	98.2
1.00	25.4	1-in.	17.50	28.2	28.2	71.8
0.750	19.1	3/4-in.	26.20	42.3	42.3	57.7
0.500	12.7	1/2-in.	31.57	50.9	50.9	49.1
0.375	9.52	3/8-in.	34.10	55.0	55.0	45.0
0.250	6.35	No. 3				
0.187	4.76	No. 4	38.61	62.3	62.3	37.7
		Pan	23.4			
0.132	3.36	No. 6				
0.094	2.38	No. 8	90 GM	16.7	68.6	31.4
0.079	2.00	No. 10	134	24.9	71.7	28.3
0.047	1.19	No. 16	189	35.1	75.5	24.5
0.033	0.84	No. 20				
0.023	0.59	No. 30	253	47.0	80.0	20.0
0.0165	0.42	No. 40				
0.0117	0.297	No. 50	273	50.7	81.4	18.6
0.0083	0.210	No. 70				
0.0059	0.149	No. 100	410	76.2	91.0	9.0
0.0041	0.105	No. 140				
0.0029	0.074	No. 200	442	82.2	93.3	6.7
		Pan				
Total weight in grams			538			

Partial percent retained = $\frac{\text{wt in grams retained on a sieve}}{\text{wt in grams of sample used for a given series of sieves}} \times 100$

Total percent retained = $\frac{\text{wt in grams retained on a sieve}}{\text{total wt in grams of oven-dry sample}} \times 100$

For an individual sieve, the percent finer by weight = percent finer than next larger sieve - percent retained on individual sieve

Remarks SELECT FILL (MIX ALL PLANT) TESTED PER ASTM C136
WELL-GRADED GRAVEL WITH SILT & SAND (GW-GM)

Technician J. BOOTH Computed by J. BOOTH Checked by DT

ENG FORM 3841 1 JUN 65

PLATE V-1

FIGURE 2-4

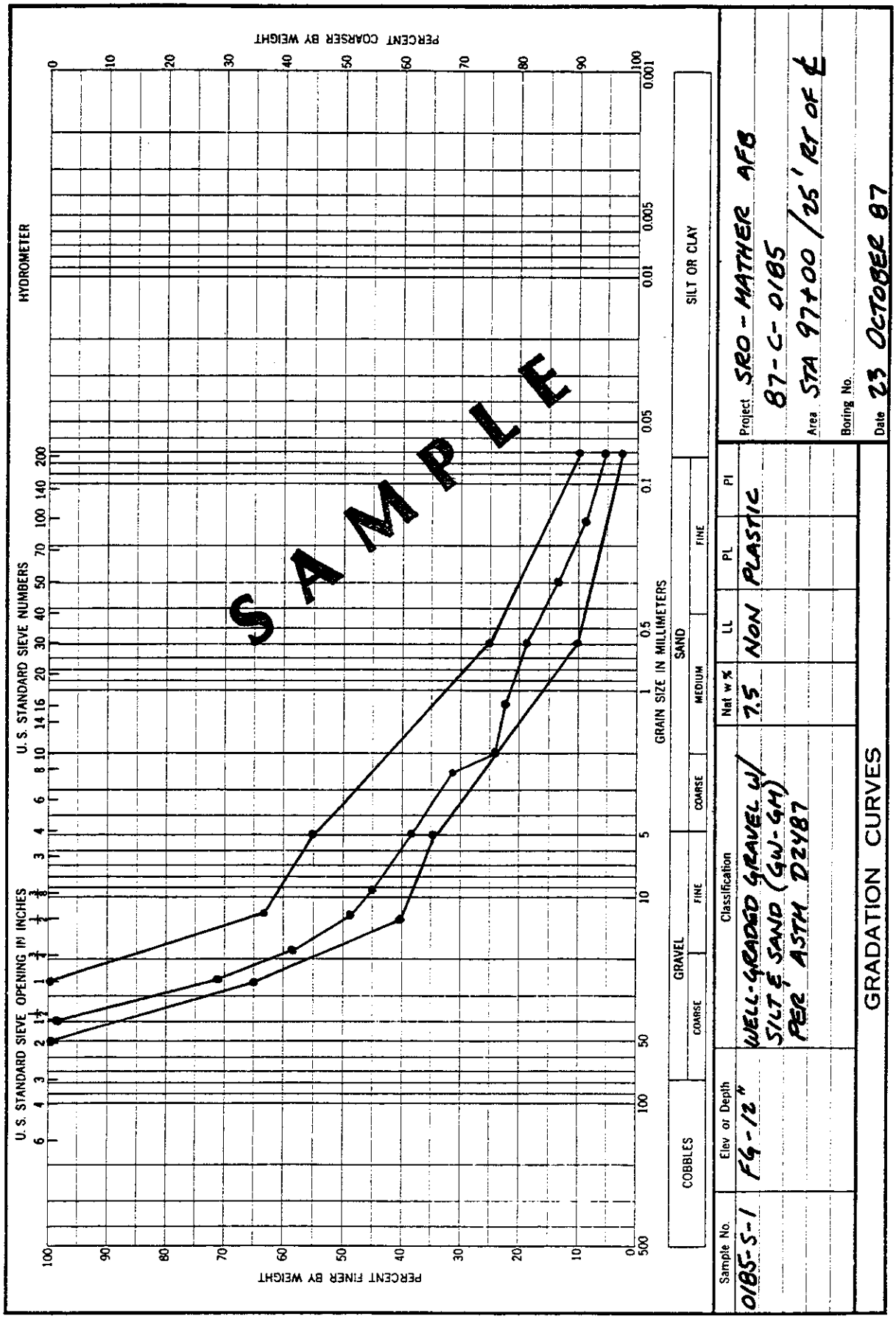

SAMPLE
HYDROMETER
U. S. STANDARD SIEVE NUMBERS
U. S. STANDARD SIEVE OPENING IN INCHES
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
GRAIN SIZE IN MILLIMETERS
COBBLES
GRAVEL
SAND
SILT OR CLAY
COARSE
FINE
COARSE
MEDIUM
FINE
Sample No.
Elev or Depth
Classification
Nat w %
LL
PL
PI
0185-S-1
F4-12'
WELL-GRADED GRAVEL W/ SILT & SAND (GW-GM) PER ASTM D2487
7.5
NON
PLASTIC
Project SRO - MATHER AFB
87-C-0185
Area STA 97+00 /25' RT OF ℄
Boring No.
Date 23 OCTOBER 87
GRADATION CURVES
TESTED BY: J. BOOTH
CHECKED BY: D. JONES

FIGURE 2-5

ATTERBERG LIMITS DETERMINATION

DATE: 23 OCT 87

PROJECT: SRQ - MATHER AFB ALTER MECHANICAL SYSTEMS CONT. NO. 87-0185

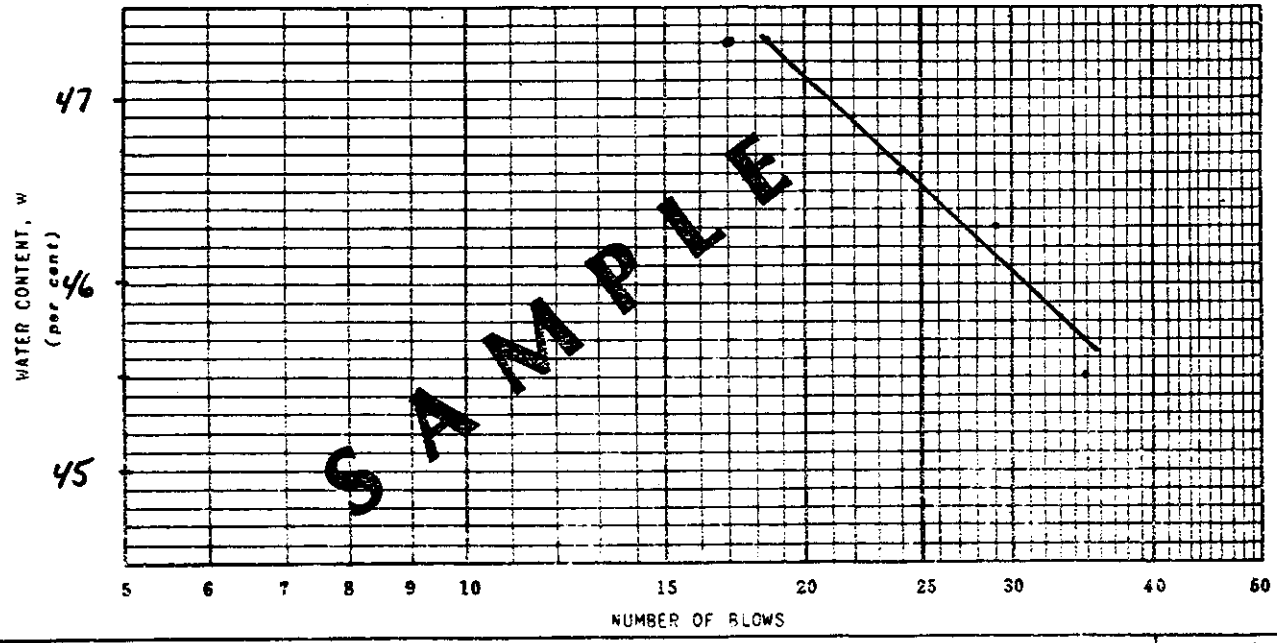
EXCAVATION NUMBER:

SAMPLE NUMBER: 0185-S-2

LIQUID LIMIT, w_L

RUN NUMBER	1	2	3	4		
TARE NUMBER	30	31	32	33		
A. WEIGHT OF WET SOIL + TARE	43.41	43.89	40.07	40.27		
B. WEIGHT OF DRY SOIL + TARE	40.08	40.52	37.16	38.39		
C. WEIGHT OF WATER, W_w (A.-B.)	3.33	3.37	2.91	2.88		
D. WEIGHT OF TARE	33.04	33.29	30.88	32.06		
E. WEIGHT OF DRY SOIL, W_s (B.-D.)	7.04	7.23	6.28	6.33		
WATER CONTENT, $w=(\frac{W_w}{W_s} \times 100)$	47.3	46.6	46.3	45.5		
NUMBER OF BLOWS	17	24	29	35		

w_L 46.5 | w_P 17.7 | $I_p (w_L - w_P)$ 28.8



PLASTIC LIMIT, w_P

RUN NUMBER	1	2	3		NATURAL WATER CONTENT
TARE NUMBER	27	28	29		23
F. WEIGHT OF WET SOIL + TARE	55.21	54.15	59.60		58.72
G. WEIGHT OF DRY SOIL + TARE	54.90	53.89	59.10		57.82
H. WEIGHT OF WATER, W_w (F.-G.)	.31	.26	.50		.90
I. WEIGHT OF TARE	53.10	52.40	56.43		55.02
J. WEIGHT OF DRY SOIL, W_s (G.-I.)	1.80	1.49	2.67		2.80
WATER CONTENT, $w=(\frac{W_w}{W_s} \times 100)$	17.2	17.4	18.7		32.1
PLASTIC LIMIT, W_p (Average w)			17.7		

REMARKS

SANDY LEAN CLAY (CL) PER ASTM D2487

TECHNICIAN (Signature)	COMPUTED BY (Signature)	CHECKED BY (Signature)
D. Jones	J. Booth	J. Booth

U. S. Government Printing Office: 1982-564-036/0419

FIGURE 2-6

SPECIFIC GRAVITY TESTS

Date 2 OCT 87

Project SRO - MATHER AFB - ALTER MECHANICAL SYSTEMS

Boring No. 0185-S-1

SPECIFIC GRAVITY OF SOLIDS (G_s)

Sample or Specimen No.			0185-S-1	0185-S-2	0185-S-3	
Flask No.			3	4	5	
Temperature of water and soil, T, °C			25	25	25	
Dish No.			4	5	6	
Weight in grams	Dish + dry soil		255.79	254.53	255.61	
	Dish		165.82	165.80	165.81	
	Dry soil	W_s	89.97	88.73	89.80	
	Flask + water at T, °C	W_{bw}	662.48	662.19	662.29	
	$W_s + W_{bw}$		752.45	750.92	752.09	
	Flask + water + immersed soil	W_{bws}	720.72	719.50	720.44	
	Displaced water, $W_s + W_{bw} - W_{bws}$		31.73	31.42	31.65	
Correction factor		K	0.9989	0.9989	0.9989	
$(W_s K) \div (W_s + W_{bw} - W_{bws})$		G_s	2.832	2.821	2.834	

APPARENT (G_a) AND BULK (G_m) SPECIFIC GRAVITY

Sample or Specimen No.			0185-S-1			
Temperature of water and soil, T, °C			23.0°C			
Weight in grams	Tare + saturated surface-dry soil		9.34			
	Tare		.53			
	Saturated surface-dry soil	B	8.81			
	(Wire basket + soil) in water		5.77			
	Wire basket in water		—			
	Saturated soil in water	C	5.77			
	Tare + dry soil		9.25			
	Tare		.61			
	Dry soil	A	8.64			
Correction factor		K	.9970			
(AK) ÷ (A - C)	(Apparent)	G_a				
(AK) ÷ (B - C)	(Bulk)	G_m	2.834			

Remarks CONTRACT NO. 87-C-0185

Technician J. BOOTH Computed by J. BOOTH Checked by D. JONES

FIGURE 2-7

CHAPTER 3

AIRFIELD AND HELIPORT PAVEMENT CONSTRUCTION, SUBGRADE, AND PROCESSED AGGREGATES

3-l. Scope. This chapter prescribes methods and procedures for the Contractor Quality Control testing of materialsused in the backfill, embankment, subgrade, subbase, and base courses, etc. for rigid and flexible airfield and heliport pavement construction. Refer to Chapter 2 for testing of other earthwork features such as building fills and trench backfill.

3-2. Tests. Testing and reporting shall be performed in accordance with the American Society for Testing and Materials (ASTM) Standards as listed below as specified in Chapters 1 and 2 of this manual.

a.	Samnling.	ASTM D 75	Sampling Aggregates.
b.	Samole Preparation.	ASTM D 2217	Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants (Method B).
c.	Gradation.	ASTM c 117	Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.
		ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates.
		ASTM D 422 Apparatus B	Particle-Size Analysis of Soils. (Only used when hydrometer
		ASTM E 11	Wire Cloth Sieves for Testing Purposes.
d.	Unit Weisht.	ASTM c 29	Unit Weight and Voids in Aggregate.

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d.	Unit Weisht.	ASTM c 29	Unit Weight and Voids in Aggregate.

e.	Specific Gravity.	ASTM C 127	Specific Gravity and Absorption of Coarse Aggregate.
		ASTM D 854	Specific Gravity of Soils.
f.	Atterberg Limits. (Procedure B)	ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
g.	Moisture Content.	ASTM D 2216	Laboratory Determination of Moisture Content of Soil.
h.	Moisture-Density Relationship.	ASTM D 1557	Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10-lb Rammer and 18-in Drop (Methods B, or D).
		EM 1110-2-1906 Appendix VI A	Moisture-Density Relations of Soil Using a 12-inch Diameter Mold.
		ASTM D 4253*	Maximum Index Density of Soils using a Vibratory Table.
i.	Field Density.	ASTM D 1556**	Density of Soil in Place by the Sand-Cone Method.
j.	Wear Test.	ASTM C 131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and impact in the Los Angeles Machine.
k.	Materials Classification.	ASTM D 2487	Classification of Soils for Engineering Purposes.

*Vibratory table shall be used for cohesionless materials for which a well-defined moisture-density relationship cannot be obtained using ASTM D 1557.

e.	Specific Gravity.	ASTM C 127	Specific Gravity and Absorption of Coarse Aggregate.
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*Vibratory table shall be used for cohesionless materials for which a well-defined moisture-density relationship cannot be obtained using ASTM D 1557.

**The field density test shall be performed in accordance with the Standard Method of Test for Density of Soil in Place, by the Sand-Cone Method, ASTM D 1556, except that in each test the weight of the disturbed sample representing the full depth of layer shall be not less than 10 pounds for fine-grained or sandy materials and 12 pounds for gravelly materials using a scale for weighing of sufficient capacity sensitive to 0.01 pounds. All field density samples shall be oven-dried in accordance with ASTM D 1556.

3-3 Sampling and Testina of Fill, Embankment. Subarade. Subbase, and Base Course Materials, etc. The sampling and testing shall be in accordance with the standard procedures referred to in this manual. The minimum number of tests required is shown in Table 3-l.

Table 3-1. Type of Tests and Frequency.

A. SURFACE PREPARATION AND FILL	
TEST	FREQUENCY
1. Field Density w/Moisture Content.	1. Two per lift for each increment or fraction of 2,500 s.y. placed during each 8-hour shift.
2. Gradation w/Atterberg Limits (from Compacted Material)*	2. One per 5 field density tests.
3. Lab Moisture-Density Relationship w/Gradation, At'cerberg Limits, Specific Gravity, and Classification (from Bulk Sample)	3. One per 5 field density tests (with not less than one per type of material) for the first 25 field density tests. Thereafter, one additional test for each change in materials.

B. SUBGRADE, SUBBASE, AND BASE COURSES**	
TEST	FREQUENCY
1. Field Density w/Moisture	1. Two per lift for each increment or fraction of 1,500 s.y. placed during each 8-hour shift.
2. Gradation w/Atterberg Limits (From Compacted Material)*	2. Two per five field density tests.

3. Lab Moisture-Density Relationship w/Gradation, Atterberg Limits, Specific Gravity, and Classification (from Bulk Sample)	3. One per 5 field density tests (with not less than one per type of material) for the first 25 field density tests. Thereafter, one additional test for each change in material.

*Compacted Sample taken adjacent to field density test site.

**Includes other imported aggregates, such as select granular material, filter, or drainage materials.

Note: Unless otherwise specified, refer to Chapter 2 regarding testing requirements for backfill of culverts and utility trenches.

In addition to the minimum testing program above, representative samples of subgrade, subbase, base, and all other earthwork materials shall be sampled by the Contractor (prior to compaction) for the first two and every tenth field density tests and submitted to the Government for testing. Samples shall be taken under direction of the Contractor's Quality Control representative. Bag samples for this purpose shall be shipped within 24 hours by the Contractor at the Contractor's expense to the Sacramento District Laboratory, Corps of Engineers, 2021 Jefferson Boulevard, West Sacramento, California 95691. Weight of these samples shall be minimum 100 pounds for material containing less than 10% plus No. 4 material, 150 pounds for material containing more than 10% plus No. 4 material, or 750 pounds for material containing more than 30% plus 3/4 inch material.

3-4. Production Control Testing of Subbase and Base Course Materials. Samples of the material shall be tested as specified, and test reports submitted at least 30 days prior to starting placement operations. These samples shall be representative and obtained at the source, from trucks, stockpiles, belts, hoppers, or other designated locations. The minimum number of tests required during production shall be two gradation tests daily. Other specified tests shall be made whenever a change of materials occurs.

3-5. Comoilation of Test Data for Submittal of Test Results. The following test results shall be submitted concurrently:

a. Moisture-Density Determinations, (Figure 2-l). This form is for use in determining the optimum moisture and maximum unit weight (density of soils and processed aggregate). The curve shall be plotted based on a minimum of four compaction test specimens. In additions, the zero-air-voids curve shall be plotted using specific gravity data obtained. Classification of sample shall be in accordance with ASTM D 2487. The Resident Contracting Officer may require, at no additional cost to the Government, single-point checks of moisture-density relations (ASTM D 1557, dry of optimum moisture), if it is evident through Quality Assurance testing that the Quality Control testing is not being adequately controlled with respect to the precision requirements of ASTM D 1557, paragraph 9.

b. Field Density Test (Sand Cone), (Figure 2-2). This test form is used to determine the degree of compaction. This sheet can also be used for recording moisture content of fill in borrow material or as placed.

c. Field Density Test (Nuclear Method), (Figure 2-3). This test form is used to determine the degree of compaction when using the Nuclear Method.

d. Gradation Sheets, (Figures 2-4 and 2-51. These forms are used to record the results of gradation tests of all materials. Figure 2-4 shows a typical example in which gradation tests were performed in accordance with ASTM Standards C 136 and C 117. Results from these tests shall be tabulated as shown in Figure 2-4.

e. Atterbers Limits Determination, (Figure 2-6). This form is used to compute liquid limit, plastic limit, and plasticity index.

f. Specific Gravity Tests. (Figure Z-7). This form is used to compute specific gravity of soils, aggregate, and stone.

CHAPTER 4

BITUMINOUS MATERIAL AND BITUMINOUS-AGGREGATE MIXTURES

4-l. **Scope.** This chapter prescribes methods and procedures for the Contractor Quality Control testing of bituminous mixtures used for the construction of streets, roads, parking area pavements, and unless otherwise specified, for the construction of airfield and heliport pavements.

4-2. Tests. Testing and reporting shall be performed in accordance with American Society for Testing Materials (ASTM) Standards as listed herein.

4-3. Mix Desian Submittals. Certain features on projects which involve comparatively small quantities of bituminous mixture (less #an 6 tons) may be excluded from testing requirements listed hereinafter, provided the material is delivered from a plant with a history of consistently producing bituminous mixtures which conform to contract requirements. The Contracting Officer's representative reserves the right to request certified test data to ensure that materials produced from the plant will conform to the contract requirements. On projects requiring more than 6 tons the Contractor shall submit the minimum items in Table 4-1, A.l. at least 30 days prior to bituminous material placement.

4-4. Minimum Test Recruirements. For placement, the minimum number of each type of production test and each type of control test are listed below. These frequencies of testing may be increased by the Contracting Officer to maintain adequate control of the bituminous mix, plant production, and placement operations.

Table 4-1. Contractor's Materials Submittal & Quality Control Testing.

A. SUBMITTALS AND TEST SAMPLE SUBMITTALS	
ITEM	REQUIREMENT
1. Mix Design* (prior to placement)	1. Test results and material sources 30 days (minimum) in advance of paving. These data shall be presented with respect

A. SUBMITTALS AND TEST SAMPLE SUBMITTALS	
ITEM	REQUIREMENT
1. Cont.	to asphalt cement content in tabulated form, as well as in graphical form, and shall include curves for unit weight, percent voids of total mix, percent voids filled, and stability; the optimum oil content shall be indicated, unless otherwise specified.
2. Hot Mix Sample (during placement)	2. Two 70-pound (minimum) samples shall be obtained from the belt or transport truck. One shall be obtained at the beginning of each 8-hour shift and one at mid-shift. Each 70-pound sample shall be split in half. The two half-samples (from beginning and mid-shift) shall be labeled packed separately and then submitted for QA testing to the Sacramento District Laboratory within 24 hours of sampling. Retain remaining two half-samples for QC testing.
3. Aggregate Sample** (during placement)	3. Two 50-pound (minimum) samples shall be obtained from the hot bins. One shall be collected at the beginning of each 8-hour shift and one at mid-shift. Each 50-pound sample shall be split in

A. SUBMITTALS AND TEST SAMPLE SUBMITTALS	
ITEM	REQUIREMENT
3. Cont.	half. The two half-samples (from the beginning and mid-shift) shall be packed separately and submitted to the Sacramento District Laboratory within 24 hours of obtaining. Retain remaining two half-samples for QC testing.
4. Bituminous Material Sample (during placement)	4. Obtain one quart of bituminous material and refinery certification of compliance and submit to Sacramento District Laboratory with first hot mix sample. Repeat anytime bituminous material source changes.
5. Core Specimens (4" diameter min.) (after each day's placement)	5. Obtain 1 set of 5 cores per each hot mix sample obtained (if possible, 2 cores from centerline of joints). Number cores and note locations obtained on as-built drawings. From each set, 2 cores shall be submitted Sacramento District to the Laboratory, (Preferably 1 core from joint). Retain remaining cores for QC testing.

B.	QUALITY CONTROL TESTING
ITEM	REQUIREMENTS
1. Bituminous Material.	1. None.
2. Aggregate.	2. On each of the split samples of aggregates retained by the Contractor, a sieve analysis and specific gravity test shall be performed.
3. Hot Mix Sample*	3. On each of the split samples retained by the Contractor, the Contractor shall determine the bitumen content and perform a complete Marshall Method test, (including stability, flow, unit-weight, percent voids of total mix and percent voids filled with bitumen). On every 10th sample the Contractor shall perform a retained-stability test.
4. Core Specimens	4. For each core specimen retained by the Contractor the relative compaction and bitumen content shall be determined. The thickness of the cores shall be measured and recorded.
5. Smoothness Testing.	5. Shall be performed by the Contractor as required by the contract documents.

Table 4-2. Reference Test Procedures

REFERENCE	TEST PROCEDURE
ASTM D 1559	Test for Resistance to Plastic flow of Bituminous Mixtures using Marshall Apparatus (mechanical agitators in the hot water baths, in addition to the other equipment, shall be required). When reouired by contract specifications, para 3.5 of ASTM D 1559 shall be changed to require 75 blows (high density pavements). Mechanical hammer may be used when properly calibrated against standard manual hammer.
ASTM D 2726	Standard Test Method for Bulk Specific Gravity of Compacted Bituminous Mixtures.
ASTM D 2172	Standard Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures, Method A or B.
ASTM C 131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C 136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates.
ASTM C 2041	Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.
ASTM C 183	Density of Hydraulic Cement.
ASTM C 188	Sampling and Acceptance of Hydraulic Cement.
ASTMC88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
ASTMD75	Sampling Aggregates, Practice.
ASTM D 140	Sampling Bituminous Materials.
ASTM D 946	Penetration-Graded Asphalt Cement for Use in Pavement Construction.

4-5. Sample Transmittal. Samples of asphalt, aggregates, cores, and hot mixes (noted in Table 4-l) shall be delivered to the Sacramento District Laboratory, Corps of Engineers, 2021 Jefferson Boulevard, West Sacramento, California 95691. These samples shall be taken under the direction of the Contractor's Quality Control representative and shall be shipped prepaid in suitable containers by the Contractor at the Contractor's *expense.* Testing of these samples in the Sacramento District Laboratory will be performed by the Government at no cost to the Contractor.

4-6. Comnilation of Test Data for Submittal of Test Results.

a. Daily Plant and Laboratorv Report - Bituminous Pavement (Figure 4-1). This form is used to record the data from the tests performed on asphaltic concrete mix samples taken prior to placement on grade and from cored samples taken from the compacted pavement. All data shall be recorded in appropriate spaces and columns according to the examples *given.*

b. Extraction Test - Hot Mix Asphaltic Concrete, (Figure 4-2). The test data for asphalt extraction shall be recorded on this form.

c. Ausreaate Gradinq Chart, (Figure 4-3) The aggregate gradings of hot bin samples and the extraction tests and specific limits shall be recorded on this form.

d. Sieve Analvsis, (Ficrure 4-4). The grading data from the hot bin samples shall be recorded on this form.

e. Marshall Method - Comvutation of Properties of Asphalt Mixture, (Figure 4-5). This work sheet form is used in recording Marshall test data and for recording field density data.

f. Theoretical Maximum Specific Gravitv. (Ficrure 4-6). This form shall be used to record test data for theoretical maximum specific gravity.

g. Bituminous Mix Design - Aggregate Blending, (Figure 4-7). This form is to be used for computations for combined gradings of aggregate for bituminous mix design.

*The theoretical maximum specific gravity of paving mixtures shall be determined in accordance with ASTM D 2041 (standard procedure). When determining Marshall properties on hot mix samples, measure the maximum specific gravity in triplicate and average. When determining Marshall properties for mix design purposes, measure the maximum specific gravity in triplicate for each design curve point and average or determine the maximum specific gravity in triplicate on the projected optimum and calculate the specific gravity of the remaining points in accordance with the Asphalt Institute Manual MS-2, Chapter VI paragraph 6.07 (May 1984, or most recent edition).

**For batch plants not utilizing hot bins, individual bin samples shall be obtained from the cold feed bins. If it is determined by the Contracting Officer's representative that representative samples cannot be readily obtained from the individual cold feed bins, representative samples shall be obtained from the combined cold feed conveyor.

DAILY PLANT AND LABORATORY REPORT BITUMINOUS PAVEMENT

PROJECT	CONT. NO.	DATE
SRO MATHER AFB ALTER. MECH. SYS. RELIANCE ENTERPRISE	87-C-0185	3 MAR 87

TIME OR SHIFT			0930		1330	
SAMPLE NO.		SPEC.	A-1		P-1	
AGG. TEMP.		275-325	310		310	
ASPHALT TEMP.		250-325	300		300	
DISCHARGE TEMP.		275-325	310		305	
ROLLING TEMP.						
UNIT WT. PCF			150.4		151.2	
STABILITY		+500	2120		2494	
FLOW		-20	14		14	
VOIDS TOTAL MIX		3-5	5.3		5.8	
VOIDS FILLED W/ASPHALT		75-85	74.7		75.4	
ASPHALT (EXTRACTED)		5-7	6.7		6.5	
GRADATION OF AGGREGATE PERCENT PASSING	1/2	100	100		100	
	3/8	84-94	91		94	
	NO. 4	63-73	72		73	
	NO. 8	47-57	50		50	
	NO. 16	-	41		41	
	NO. 30	-	30		30	
	NO. 50	23-31	24		24	
	NO. 100	13-21	14		13	
	NO. 200	4-8	7		8	
GRADATION OF HOT BINS PERCENT PASSING	1/2	100	100		100	
	3/8	84-94	91		91	
	NO. 4	63-73	66		71	
	NO. 8	47-53	50		49	
	NO. 16	-	41		41	
	NO. 30	-	33		33	
	NO. 50	23-31	23		24	
	NO. 100	13-21	13		14	
	NO. 200	4-8	6		7	

SAMPLE

DATA FROM PAVEMENT CORES

SAMPLE NO.	A-1-1	A-1-2	A-1-3J	P-1-1	P-1-2	P-1-3J
DATE PAVEMENT PLACED	3-3-87	3-3-87	3-3-87	3-3-87	3-3-87	3-3-87
THICKNESS (INCHES)	1 7/8"	2"	1 13/16"	1 13/16"	1 7/8"	1 3/16
UNIT WT. PCF	143.0	144.0	143.8	146.8	144.3	144.4
REL. DENS.	95.1	95.8	95.6	97.0	95.4	95.3
VOIDS						
VOIDS FILLED W/ASPHALT						

BATCH PROPORTIONS			
BIN NO. 1	2575	51.5	TYPE OF PLANT: BATCH - PCA, FAIR OAKS
BIN NO. 2	1170	23.4	TONS PLACED THIS DATE: 537
BIN NO. 3	935	18.7	GRADE OF ASPHALT: AR 4000 SHELL OIL
BIN NO. 4			REMARKS: AMBIENT TEMP. 48°F MINIMUM
ASPHALT	320	6.4	ASPHALT CONCRETE FOR
TOTAL	5000	100.0	ACCESS RD STA 4+75

SUBCONTRACTOR: DELTA PAVING CO.

SIGNED BY D. Jones
PROJECT ENGINEER

FIGURE 4-1

CORPS OF ENGINEERS
EXTRACTION TEST
HOT MIX ASPHALTIC CONCRETE

TESTED BY: VALLEY ENG (LABORATORY)

PROJECT	LAB NO	DATE
SRO-MATHER AFB (ALTER. MECH. SYS)	87-C-0185	3 MAR 87
LOCATION OF SAMPLE	**FIELD NO**	**TESTED BY**
ACCESS RD. STA. 4+75	A-1	J. BOOTH

UNIT WEIGHT

A. WEIGHT IN AIR		C. LOSS IN WEIGHT	
B. WEIGHT IN WATER		D. UNIT WEIGHT (A/C)	

ASPHALT CONTENT

A. WT. BEFORE EXTRACTION	1064	F. VOL. IN ML OF BITUMEN SOL.	200
B. WT. AFTER EXTRACTION	993	G. WT. OF ASH/100 ML	0.5
C. WT. OF FILTER AND AGG.	38	H. TOTAL WT. OF ASH $(\frac{F \times G}{100})$	1.0
D. INITIAL WT. OF FILTER	36	I. TOTAL WT. EXTRACTED AGG. (B + E + H)	996
E. WT. OF AGG. RETAINED (C-D)	2	J. PER CENT ASPHALT $\frac{100\,(A - B - E) - FG}{A}$	6.39

GRADING OF AGGREGATE

DRY WEIGHT OF SAMPLE BEFORE TEST (1) 995 GMS.

SIEVE SIZE	WEIGHT RETAINED	CUMULATIVE WT. RETAINED	CUMULATIVE PER CENT RETAINED	PER CENT PASSING	
3/4"					
1/2"		0	0	100.0	
3/8"		61	6.1	93.9	
No. 4		272	27.3	72.7	
8		498	50.0	50.0	
30		697	70.0	30.0	
50		759	76.3	23.7	
100		871	87.5	12.5	
200		920	92.5	7.5	
PAN		75	100.0		

REMARKS: % ASPHALT WITHOUT ASH CONSIDERED

$$100\left(\frac{A-B-E}{A}\right) \quad 100\left(\frac{1064-993-2}{1064}\right) = \frac{6900}{1064} = 6.48\%$$

TECHNICAN (Signature)	COMPUTED BY (Signature)	SUBMITTED BY (Signature)
J. Booth	J. Booth	D. Jones

FIGURE 4-2

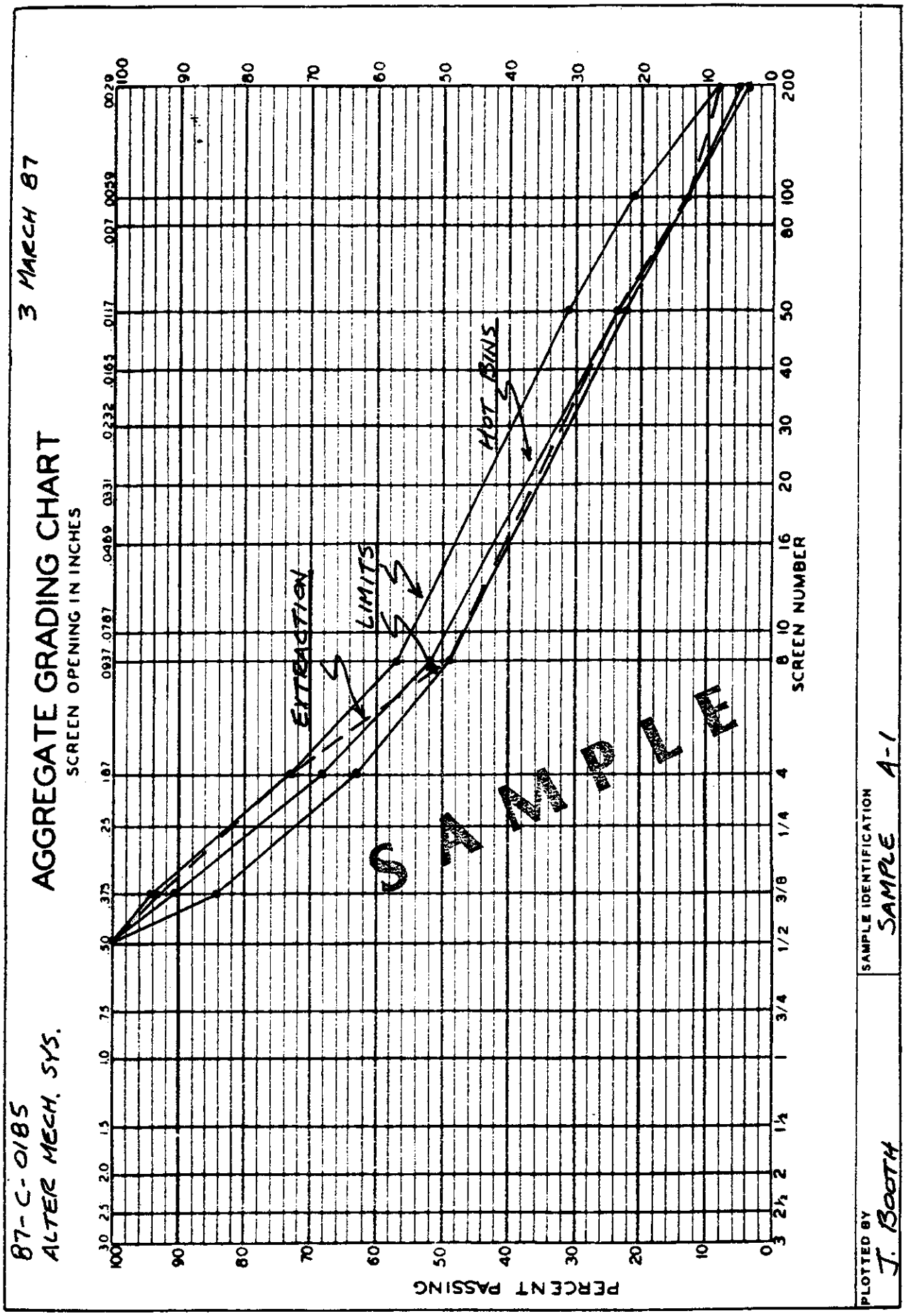

AGGREGATE GRADING CHART
SCREEN OPENING IN INCHES
3 MARCH 87
87-C-0185
ALTER MECH. SYS.
EXTRACTION LIMITS
HOT BINS
SAMPLE
PERCENT PASSING
SCREEN NUMBER
SAMPLE IDENTIFICATION
SAMPLE A-1
PLOTTED BY
J. BOOTH

FIGURE 4-3

SIEVE ANALYSIS

JOB NO.: 87-0185 | PROJECT: SRO-MATHER ALTER. MECH. SYS. | DATE: 3 MAR 87

DRY GRADATION

SAMPLE NO. BIN #3

U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS
3/4			
1/2	0	0	100.0
3/8	7.55	48.7	51.3
NO. 4	14.38	92.8	7.2
NO. 8	15.33	98.9	1.1
NO. 16	.17	1.1	
NO. 30			
NO. 50			
NO. 100			
NO. 200			
-200			
TOTAL	15.50		

WEIGHT ORIGINAL SAMPLE

SAMPLE NO. BIN #2

U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS
3/4			
1/2	0	0	100.0
3/8	1.6	.2	99.8
NO. 4	391.5	50.2	49.8
NO. 8	702.8	90.1	9.9
NO. 16	—	—	
NO. 30	758.1	97.2	2.8
NO. 50	770.6	98.8	1.2
NO. 100	773.7	99.2	.8
NO. 200	6.3	.8	
-200			
TOTAL	780.0		

WEIGHT ORIGINAL SAMPLE

WASHED GRADATION

SAMPLE NO. BIN #1

U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS
3/4			
1/2			
3/8	0	0	100.0
NO. 4	2.8	.7	99.3
NO. 8	44.8	11.2	88.8
NO. 16	—	—	—
NO. 30	184.8	46.2	53.8
NO. 50	223.6	55.9	44.1
NO. 100	304.4	76.1	23.9
NO. 200	362.8	90.7	9.3
-200 (T)	37.2	9.3	
TOTAL	400.0		

(A) WEIGHT ORIGINAL SAMPLE 400.0 GM
(B) WEIGHT AFTER WASHED 371.2 GM
(C) WASH LOSS (A - B) 28.8 GM
(S) -200 FROM SIEVING 8.4 GM
(T) TOTAL -200 C + S 37.2 GM
USE "T" TO CALCULATE PERCENTAGES

SAMPLE NO. _____

U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS
3/4			
1/2			
3/8			
NO. 4			
NO. 8			
NO. 16			
NO. 30			
NO. 50			
NO. 100			
NO. 200			
-200 (T)			
TOTAL			

(A) WEIGHT ORIGINAL SAMPLE _____ GM
(B) WEIGHT AFTER WASHED _____ GM
(C) WASH LOSS (A - B) _____ GM
(S) -200 FROM SIEVING _____ GM
(T) TOTAL -200 C + S _____ GM
USE "T" TO CALCULATE PERCENTAGES

SAMPLE

TESTED BY: J. BOOTH | COMPUTED BY: J. BOOTH | CHECKED BY: D. JONES

FIGURE 4-4

MARSHALL METHOD - COMPUTATION OF PROPERTIES OF ASPHALT MIXTURES

DATE OF COMPUTATION: 3 MAR 87

JOB NUMBER: 87-0185

PROJECT: MATHER - ALT. MECH. SYS.

DESCRIPTION OF BLEND: 3/8" MAXIMUM ASPHALT CONCRETE

SPECIMEN NUMBER	ASPHALT CEMENT (Percent)	THICKNESS (Inches)	WEIGHT (Grams) IN AIR	WEIGHT (Grams) IN WATER	VOLUME CC	SPECIFIC GRAVITY ACTUAL	SPECIFIC GRAVITY THEORIZED	AC BY VOLUME (Percent)	VOIDS (Percent) TOTAL MIX	VOIDS (Percent) FILLED	UNIT WEIGHT TOTAL MIX (Lb./Cu.Ft.)	STABILITY (Pounds) MEASURED	STABILITY (Pounds) CONVERTED	FLOW UNITS OF 1/100 IN.
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
					(d - e)	(d)/(f)		(b x g)/(Sp.Gr. of AC)	(100 - 100(g)/(h))	(i)/(i + j)	(g x 62.4)		*	
	1.030													
R	6.7	2 1/2"	1231.7	720.4	511.3	2.409						2160	2160	14
L		2 1/2"	1239.7	725.3	514.4	2.410						2080	2080	13
									3-5	75-85				
					AVG.	2.410	2.544	15.677	5.3	74.7	150.4		2120	14
R	6.5	2 3/8"	1164.0	686.0	478.0	2.435						2206	2508	14
L		2 1/2"	1226.0	717.0	509.0	2.409						2408	2480	14
					AVG.	2.423	2.552	15.291	5.0	75.4	151.2		2494	14
					CORES									
A-1		1 7/8"	889.3	501.3	388.0	2.292					143.0	95.	1%	
AJ-1		1 17/16	871.8	493.4	378.4	2.304					143.8	95.	6%	
A-2		1 13/16	870.5	510.0	370.0	2.353					146.8	97.	0%	
AJ-2		1 3/16	553.0	314.0	239.0	2.314					144.4	95.	3%	

* From conversion table

COMPUTED BY: J. BOOTH

CHECKED BY: D. JONES

FIGURE 4-5

MARSHALL METHOD - COMPUTATION OF PROPERTIES OF ASPHALT MIXTURES

DATE OF COMPUTATION

JOB NUMBER | PROJECT | DESCRIPTION OF BLEND

SPECIMEN NUMBER	ASPHALT CEMENT (Percent)	THICKNESS (Inches)	WEIGHT (Grams)		VOLUME CC	SPECIFIC GRAVITY		AC BY VOLUME (Percent)	VOIDS (Percent)		UNIT WEIGHT TOTAL MIX (Lb./Cu.Ft.)	STABILITY (Pounds)		FLOW UNITS OF 1/100 IN.
			IN AIR	IN WATER		ACTUAL	THEORIZED		TOTAL MIX	FILLED		MEASURED	CONVERTED	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
					(d - e)	$\frac{(d)}{(f)}$		$\frac{(b \times g)}{(Sp.Gr.\ of\ AC)}$	$(100 - 100\frac{(g)}{(h)})$	$\frac{(i)}{(i + j)}$	(g x 62.4)		*	

* From conversion table

COMPUTED BY

CHECKED BY

DD FORM 1 DEC 68 1218

PREVIOUS EDITION OF THIS FORM IS OBSOLETE.

4-1252

MAXIMUM THEORETICAL SPECIFIC GRAVITY
ASPHALT CONTENT
ASTM D 2041
METHOD C

CONTRACT NUMBER: 87-C-0185

DATE SAMPLED: 3 MARCH 87

DATE TESTED: 3 MARCH 87

PROJECT: MATHER AFB - ALTER. MECH. SYS.

A = Dry Weight of Sample (g)
D = Weight of Pycnometer + Water (77°F) (g)
E = Weight of Pycnometer + Sample + Water (g)
S = SSD Weight of Sample (g) - Substitute for 'A' in Denominator of Equation if Dry Back Method is Used

$$SG = \frac{A}{A + D - E}$$

OIL CONTENT 6.5
A = 1546.5
D = 2735.8
SG = 2.552

Water Temp (°F) 77°
E = 3676.3
S = 1551.3
*SG (Corr for Temp) = 2.552

OIL CONTENT _____
A = _____
D = _____
SG = _____

Water Temp (°F) _____
E = _____
S = _____
*SG (Corr for Temp) = _____

OIL CONTENT _____
A = _____
D = _____
SG = _____

Water Temp (°F) _____
E = _____
S = _____
*SG (Corr for Temp) = _____

OIL CONTENT _____
A = _____
D = _____
SG = _____

Water Temp (°F) _____
E = _____
S = _____
*SG (Corr for Temp) = _____

SAMPLE

FIGURE 4-6

BITUMINOUS MIX DESIGN - AGGREGATE BLENDING

DATE: 1 AUG. 87

PROJECT: SRO-MATHER AFB (ALTER MECH. SYS.)

JOB: 87-0185

AGGREGATE GRADATION NUMBER: 0185-A-1

GRADATION OF MATERIAL

SIEVE SIZE (To be entered by Technician): →	3/4"	1/2"	3/8"	No. 4	8	30	50	100	200			
MATERIAL USED	PERCENT PASSING											
BIN #3		100	51	7	1							
#2		100	100									
#1		100	100									
DESIRED:		100	84-94	63-73	49-57	—	23-31	13-21	4-8			

COMBINED GRADATION FOR BLEND - TRIAL NUMBER

SIEVE SIZE (To be entered by Technician): →		3/4"	1/2"	3/8"	No. 4	8	30	50	100	200			
MATERIAL USED	% USED	PERCENT PASSING											
BIN #3	20		20	10	1								
#2	25		25	25	13	3	1						
#1	55		55	55	54	49	30	24	13	5			
BLEND:			100	90	68	52	31	24	13	5			
DESIRED:			100	84-94	63-73	49-57	—	23-31	13-21	4-8			

COMBINED GRADATION FOR BLEND - TRIAL NUMBER

SIEVE SIZE (To be entered by Technician): →													
MATERIAL USED	% USED	PERCENT PASSING											
		EXAMPLE											
BLEND:													
DESIRED:													

FIGURE 4-7

CHAPTER 5

CONCRETE

5-l. Scope. This chapter prescribes methods and procedures for the Contractor Quality Control testing of concrete materials used in the construction of buildings and other facilities and will be prescribed in the contract documents for the respective projects.

5-2. Mix Desians. For projects involving 1,200 cubic yards or more of concrete, a job mix design shall be made for each class of concrete, unless otherwise specified. For projects involving less than 1,200 cubic yards, an established plant mix design may be used, for each class of concrete, provided it meets all specified requirements.

5-3. Excepted Features. Certain features which involve small quantities of concrete (10 cubic yards or less) may be excluded from the testing requirements shown in Table 5-1, provided the material delivered is from a plant consistently producing concrete which conforms to the requirements of the contract documents. The Contracting Officer's representative reserves the right to request supporting test data reports in evidence of plant and materials conformance with the aforementioned documents. Some typical excepted project features are nonstructural concrete curbs and gutters, sidewalks, duct backfill, thrust and anchor blocks, pole anchorage, lean concrete backfills, and manhole works. Project features such as isolated, continuous, and strip footings for the wall and columns, piles and pile caps, exterior vehicular slabs, interior on-grade floor slabs, and similar structurally related building features are not to be considered excluded items regardless of the quantities of concrete required.

5-4. Minimum Test Reouirements. A minimum number of production and control tests are listed below. The frequency of testing may be increased or decreased as directed by the Contracting Officer to maintain adequate control of the concrete mix, plant productions, and placement operations.

Table 5-1. Test Requirements.

ITEM	REQUIREMENT
1. Concrete Mix Design	1. Mix design for each class of concrete shall include all of the following data: (a) Weights and volumes of all materials. (b) Water-cement ratio by weight. (c) 7 and 28-day compressive strengths. (d) Air Content. (e) Slump. (f) Unit weight (also 28-day air-dry unit weight for lightweight concrete). (g) For class P concrete, flexural beam strength tests for 7, 28, and 90 days, as specified. (h) Certified test reports of aggregate compliance with ASTM C 33 (ASTM C 330 for lightweight aggregate) or other specified standards. (i) Certification of admixture compliance with the requirements as stated in the contract documents.

ITEM	REQUIREMENT
1. Cont.	(j) Certified test reports for cement and pozzolan, accompanied by Mill Test Reports from a plant with a record of high quality production for the past 3 years.
2. Slump, Entrained Air, Unit Weight (Lightweight Concrete Only), Temperature of Mix	2. Three per day per 8-hr shift as minimum and whenever there is a change in consistency of concrete. Samples shall be taken at the point of discharge as stated by ASTM C 172, unless otherwise specified. Samples shall be taken at the beginning, midpoint, and end of each daily placement of each concrete used.
3. Test Cylinders	3. One set of three cylinders shall be made for each increment or fraction of 150 c.y. placed during each 8-hour shift. For lightweight concrete, a minimum of one set of four cylinders shall be taken. One cylinder shall be used to determine 28-day air-dry unit weight. If the consistency of the concrete (as measured by the slump test) exceeds the maximum slump obtained in the design mix or by the contract requirements, then one additional set of

ITEM	REQUIREMENT
3. Cont.	represent any deficient concrete already delivered to the forms. Any remaining concrete at the site exceeding the slump stated above shall be removed from the site at no additional cost to the Government. All subsequent batches shall be tested for slump until the necessary adjustments have been made to ensure that concrete delivered to the forms does not exceed the maximum slump.
4. Test Beams	4. For flexural concrete, one set of four beams shall be made for each increment or fraction of 300 c.y. placed during each 8-hour shift. Additional sets may be required when concrete slump or mix proportions are adjusted. Additional sets will be required when the concrete slump is excessive as stated in Item 3 above, or when mix proportions are adjusted.
5. Plant and Mixing Equipment Compliance Tests and Materials Tests at Plant	5. Contractor compliance with ASTM C 94 "Standard Specifications for Ready Mix Concrete", with documentation, reports, or certification of compliance upon request by the Contracting Officer.

*Where pumping is approved samples for slump test shall be obtained prior to entering the pump.

5-5. Admixtures. Except where authorized by the specifications, any admixture other than an air-entraining agent is not to be used in concrete without prior approval of the Contracting Officer. The admixture type proposed for use will be thoroughly investigated in laboratory tests of concrete made with the cement and aggregate proposed for use on the project. Minimum test requirements will include the effect of the admixture on strength of concrete at an age of 28 days and may include strength test of up to 90 days, as well as on such other properties as may be necessary to demonstrate that there will be no adverse effect on the concrete. Continued use of any approved admixture other than entrained air will be based on satisfactory control of the concrete under all conditions in the field.

5-6. Methods of Curing. Several different methods of curing are suitable, and the Contractor is given the option of selecting a preferred method in accordance with ACI requirements, unless otherwise specified. However, any curing method that has proved unsatisfactory in a particular geographic area will not be permitted for projects in that area. All materials and equipment necessary for curing and protecting the concrete must be available on the job before concrete placement is started, and no delays in starting the curing will be tolerated. Curing procedures will include provisions for attaining proper moisture and temperature conditions in the concrete. Experience has indicated that evaporation shrinkage cracking can be controlled by moist curing of the concrete under wet covers for a minimum of 24 hours after placement. To prevent excessive heat loss and promote hydration, it is important that the covers extend over the forms as well as the concrete surface. Fog-spraying equipment should direct a very fine mist of water onto the concrete surface until curing under wet covers can be started. During cold weather, other approved methods of curing providing adequate protection against rapid heat loss from the concrete shall be used during the early hardening period. Precautions shall also be taken at the end of the curing period to avoid rapid cooling of the concrete and the resulting development of undesired stresses.

5-7. Procedures for Sampling and Testing.

a. Testing and reporting shall be performed in accordance with the American Society for Testing and Materials (ASTM) Standards as follows: Sampling Fresh Concrete', ASTM C 172; Slump of Portland Cement Concrete, ASTM C 143; Air Content of Freshly- Mixed Concrete by Pressure Method, ASTM C 231 (for lightweight concrete use

volumetric method, ASTM C 173); and Unit Weight, Yield, and Air Content (Gravimetric) of Concrete, ASTM C 138, with the exception that a 0.25 cubic-foot container, such as the lower part of an air meter, may be used in place of the 0.50 cubic-foot capacity specified for concrete with coarse aggregates up to 1-1/2 inch maximum size.

b. The minimum number of cylinder specimens shall be three per set (one for 7-day and two for 28-day compressive strength tests). For lightweight concrete, one additional cylinder specimen shall be taken to test for 28-day air-dry unit weight. Additional specimen shall be made if required to establish strengths for form stripping or other purposes. Concrete samples shall be secured in conformance with Standard Method of Sampling Fresh Concrete, ASTM C 172, and test specimens fabricated and cured in accordance with Standard Method of Making and Curing Concrete Compression Test Specimens in the Field, ASTM c 31. Cylinders shall be tested in accordance with Standard Test Method for Compressive Strength of Molded Concrete Cylinders, ASTM C 39. Unit weight shall be tested in accordance with Standard Test Method for unit weight for Structural Lightweight Concrete, ASTM C 567.

c. Use of plastic molds, in lieu of other approved molds, will be based upon the following:

(1) Prior approval as to type, dimensions, and other properties shall be required.

(2) Plastic molds will not be reused.

d. Field adjustment of approved water-cement ratios.

(1) Addition of water to the plastic concrete at the job site will not be permitted, except when directed by the Contractor's Quality Control representative with the approval of the Contracting Officer's representative.

(2) Adjustment of the concrete mix at the job site will be cause for rejection in the absence of compliance with the above provision.

(3) Adjustments, if required, will be made by the supplier at the point of mixing and the water-cement ratio of the concrete delivered to the project shall not exceed that ratio which has been previously submitted and approved.

e. Unless otherwise specified, the minimum number of beams shall be four per set and shall be tested for flexural strength in pairs at 7 and 28 days. Additional beams shall be made, if required, to establish strengths after changes in mix proportions are made. Concrete samples shall be secured in conformance with Standard Method of Sampling Fresh Concrete, ASTM C 172 and test specimens shall be fabricated and cured in accordance with Standard Method for Making and Curing Concrete Test Specimens in the Field, ASTM C 31. Beams shall be tested in accordance with Standard Method of Test for Flexural Strength of Concrete, ASTM C 78.

f. The coarse and fine aggregates shall be tested weekly at the plant for gradation and the amount of surface moisture of the fine and coarse aggregate shall be determined prior to batching. Additional gradation and moisture testing may be required by the Contracting Officer at no additional cost to the Government, if it is evident that there is excessive variation in the consistency of the concrete delivered to the project site. The procedure outlined in Standard Method of Testing for Sieve or Screen Analysis of Fine and Coarse Aggregates, ASTM C 136, and Standard Method of Test for Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing, ASTM C 117 shall be followed for gradation test. Moisture tests are to be performed in accordance with the Standard Method of Test for Total Hoisture Content of Aggregate, ASTM : C 566. Other methods such as the use of a graduated volumetric flask may be used, provided accurate moisture contents based on saturated-surface-dry conditions are obtained.

g. Evaluation of the Contractor's mixers and concrete handling equipment shall be made periodically throughout the construction period to ensure that no concrete of marginal quality due to segregation is being placed in any structure. The compliance tests which provides the test data for this evaluation is described in the specification for Ready Mixed Concrete, ASTM C 94.

h. In addition to the minimum testing program above, for large projects only (greater than 1200 c.y.), samples consisting of 15 pounds of fine aggregate, 25 pounds of 3/4" x #4 coarse aggregate, and 35 pounds of 1-1/2" x 3/4" coarse aggregate used in concrete mix shall be delivered only upon reouest to Sacramento District Laboratory, Corps of Engineer, 2021 Jefferson Boulevard, West Sacramento, California 95691. These samples

shall be taken under the direction of the Contractor's Quality Control representative and shall be shipped prepaid in suitable containers by the Contractor at the Contractor's expense. Testing of these samples will be performed by the Government at no cost to the Contractor.

5-8. Compilation of Test Data for Submittal of Test Results.

a. Concrete Field Control, (Figure 5-1). This form is to be used for reporting results of concrete tests performed on concrete during the placement.

b. Concrete Test Specimens, (Figure 5-2). This form shall be used when submitting compressive and flexural test results. It shall be completed showing the required information including the batch weights of cement, water, and the fine and coarse aggregate as corrected for surface moisture and the mix design weights per cubic yards in addition to other pertinent tests noted in Table 5-1. The result of each strength test shall be submitted for each age interval.

c. Sand Test (Figure 5-3), and Aggregate Gradina, (Figure 5-4). The results shall be computed and plotted on the appropriate form.

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

CONCRETE FIELD CONTROL

PROJECT SRO - Mather AFB - Alter Mech. Sys.	DATE 26 Jul 87
CONTRACTOR Sacramento Ready Mix Co.	CONTRACT NO. 87-C-0185
LOCATION OF PLACEMENT Slab - 3rd Floor	CLASS OF CONCRETE Class AA & Lightweight

SPECIFICATIONS: C.F. 6.0 W/C 5.0 SLUMP RANGE 3"-4"

TIME	WATER ADDED GALS.	SLUMP	% AIR	PLASTIC UNIT WT.	MIX TEMP.	CYLINDERS (No. and Comments)
7:30	Truck No. 212 35	5"	—	—	62°	Class AA-Colored Concrete
7:52	Truck No. 221 0	3"	4.2	111.8	65°	LT. WT. Concrete
8:15	Truck No. 212 25	5"	5.0	109.2	68°	LT. WT. Concrete Corps Cyl No. L-44 Mech Contractor's No. 11L-305
8:32	Truck No. 221	4"	—	—	71°	LT. WT. Concrete
9:05	Truck No. 212 0	6"	—	—	70°	Rejected By Inspector
9:33	Truck No 220 0	5"	—	—	70°	CQC Called the plant to warn of excessive slump
9:52	Truck No. 221 10	3 3/4"	4.5	113.6	70°	LT. WT. Concrete
10:20	Truck No. 201 10	5"	—	—	70°	Rejected by CQC
10:45	Truck No 219 8	4 1/2"	—	—	69°	—
11:05	Truck No. 220 5	4 1/2	1.4	113.0	70°	LT. WT. Concrete Corps Cyl. No. L-45

REMARKS

* Plant samples for moisture and gradation tests taken while loading the first load of lightweight concrete in Truck No. 212.
Total of 295 Cu. Yds. Placed

TESTED BY	SUBMITTED BY
J. Booth	D. Jones

SPD FORM 58
1 OCT 72

FIGURE 5-1

CESPK FAM 415-1-2

15 Jun 89

CONCRETE CONTROL DATA

PROJECT NAME: SRO-MATHER AFB - ALTER. MECH. SYS.		CONTRACT NO.: 87-C-0185
CONCRETE PRODUCER: SAC. READY MIX CO.	BATCH PLANT LOCATION: SACRAMENTO & CAPITOL, SAC.	SPECIMEN TYPE: ☒ CYLINDER ☐ BEAM
LOCATION OF PLACEMENT: BUILDING A FLOOR SLAB LINE 3.5-5, C-7-11, 1.2-2.4 & C-7-K		
CEMENT TYPE: II / BRAND: BEST CEM. CO.	SK/CU YD: 4.8 / MIX NO.: CM-3000	AIR ENTRAINMENT ADMIXTURE: BRAND: DAREX AEA
AGGREGATE PRODUCER: MIX ALL AGG	SAND SOURCE: MIX ALL AGG	ROCK SOURCE: MIX ALL AGG
STRENGTH REQUIREMENT: 3000 PSI AT 28 DAYS	BATCH TICKET NO.: 09022 / TRUCK NO.: 16	DATE SPECIMENS MOLDED: 13 JAN 1988

FIELD MIX DATA

AGG MOIST % a	MATERIAL b	BATCH WEIGHTS c	FREE MOIST IN LBS d	COMPUTED SSD WEIGHT e	SPECIFIC GRAVITY f	ABSOLUTE VOLUME g	QUANTITIES PER CU YD h	DESIGN WEIGHT i
		FROM BATCH TICKET	$\frac{a}{100+a} \times c$	c-d	FROM MIX DESIGN	$\frac{e}{f(62.4)}$	* $\frac{e}{\text{YDS BATCHED}}$	FROM MIX DESIGN
	CEMENT	4050		4050	3.15	20.6	451	451
6%	SAND	14,150	801	13,349	2.63	81.3	1,488	1488
1½%	COARSE AGG #1 SIZE NO.	15,350	76	15,274	2.68	91.3	1,698	1703
	COARSE AGG #2 SIZE NO.							
	ADMIXTURE TOTAL OZ							
WATER IN AGGREGATES (ADD COL d)			877					
WATER ADDED AT BATCH PLANT (LBS)			1550	TOTAL WATER			TIME SPECIMENS MOLDED	9:00 A.M.
WATER ADDED AT JOSITE (LBS)			41.7 (SG)	2469	1.00	39.56		

CONC. TEM	SLUMP	AIR CONTENT	TOTAL VOLUME OF BATCH (add col. g) / 27 (less .27 for each percent air)	
68°F	2¾"	4.1		$\frac{232.8}{25.89} = 8.99$ CU YDS

UNIT WEIGHT OF CONCRETE	SPECIMENS MADE BY	W/C BY WEIGHT (ACTUAL) TOTAL WATER / CEMENT WEIGHT (COL c)	W/C FROM MIX DESIGN
150.0 LBS/CU FT	D. JONES	= .61	275/451 = .61

DATE/TIME SPECIMENS PLACED IN CURING TANK	TESTING AGENCY	SPECIMENS TESTED BY
14 JAN 88 / 9:30 A.M.	SACRAMENTO TESTING, INC.	J. BOOTH

* FROM BATCH TICKET

REMARKS

RESULTS OF LABORATORY TESTS

FIELD NO.	BREAK DATE	AGE DAYS	TOTAL LOAD LBS	UNIT STR. LBS/SQ. IN	REMARKS
0185-C-1A	1/20/88	7	65,500	2317	PLASTIC MOLDS
1B	2/17/88	28	93,600	3290	
1C	2/17/88	28	93,650	3313	

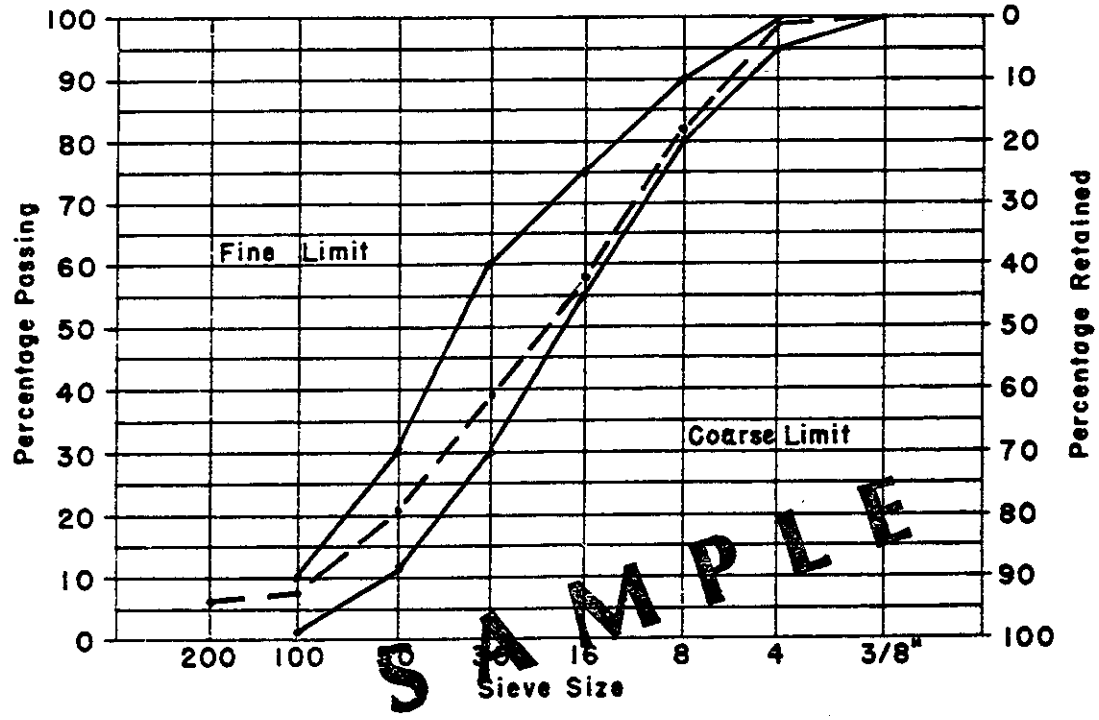
FIGURE 5-2

SAND TEST

Sampled by J. BOOTH Lab. No 185-C-001

Remarks SACRAMENTO READY MIX CO. Date 1 AUG 87

SRO - MATHER AFB - ALTER. MECH. SYS. - 87-C-0185



412 GMS DRY

Sieve Size	Ret. on Each Sieve: Grams	%	Cum. Ret. %	Cum. Pass. %	
3/8"	0	0	0	100.0	100
NO. 4	7	1.7	1.7	98.3	95-100
" 8	73	17.7	19.4	80.6	80-90
" 16	97	23.6	43.0	57.0	55-75
" 30	76	18.4	61.4	38.6	30-60
" 50	69	16.8	78.2	21.8	12-30
"100	55	13.3	91.5	8.5	2-10
"200	14	3.4	94.9	5.1	
Pan	21	5.1	100.0		

F.M. 2.95 Moisture 4.6 % as rec'd

Wt./ft.^{3}: Std. _____ Lbs. Loose _____ Lbs.

Organic Matter: _____ (Color) _____ (No.)

Structural Strength: _____

Sp. Gr.: _____ Voids: _____ %

Silt & Clay 5.1 % Soundness _____ %

Tested by: DJ. Date: 1 AUG 87

FIGURE 5-3

AGGREGATE GRADING

PROJECT	SPEC NUMBER	LAB NUMBER	TESTED BY	DATE
SRO-MATHER-ALT. MECH. SYS.	5764A	185-C-001	J. BOOTH	14 AUG 87
CONTRACTOR	**CONTRACT NUMBER**	**SOURCE**	**AGGREGATE PRODUCER**	
SACRAMENTO READY MIX CO.	87-C-0185	PLEASANTON, CA.	MIX ALL	

COARSE AGGREGATE SIEVE ANALYSIS

FRACTION SIZE (3/4"-NO 4) C33, SIZE 67 WEIGHT OF SAMPLE 25.77 DRY

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	CUMULATIVE PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPEC. LIMITS
1 1/2"					
1"	0	0	0	100.0	100
3/4"	2.47	9.6	9.6	90.4	90-100
1/2"	7.51	29.1	38.7	61.3	-
3/8"	7.47	29.0	67.7	32.3	20-55
NO. 4	6.88	26.7	94.4	5.6	0-10
NO. 8	1.44	5.6	100.0		0-5

FRACTION SIZE (1 1/2"-3/4") C33, SIZE 4 WEIGHT OF SAMPLE 22.75 DRY

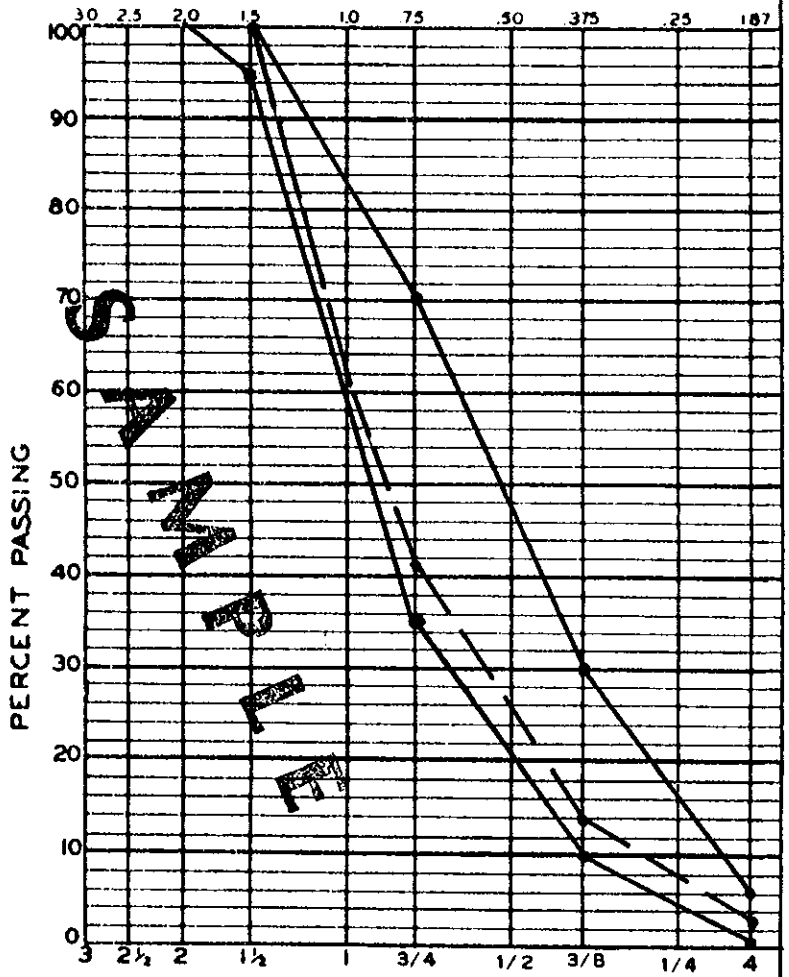
SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	CUMULATIVE PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPEC. LIMITS
2" or 3"					100
1 1/2"	0	0	0	100.0	90-100
1"	15.11	66.4	66.4	33.6	20-55
3/4"	5.97	26.2	92.6	7.4	0-15
3/8"	1.31	5.8	98.4	1.6	0-5
NO. 4	.36	1.6	100.0		
#8 or PAN					

CALCULATION OF COMBINED GRADATION

SIZE	% in mix	Percent Passing 2"	1 1/2"	1"	3/4"	3/8"	#4	#8
3/4" x #4	39.9		39.9	39.9	36.1	12.9	2.2	
1 1/2" x 3/4"	60.1		60.1	20.2	4.4	1.0	0	
Combined grading			100.0	60.1	40.5	13.9	2.2	

COARSE AGGREGATE GRADING CHART

CRD NO. _____ OR ASTM C 136



REMARKS

COMBINED GRADING MEETS ASTM C-33, SIZE 467 (1½" x No. 4)

FIGURE 5-4

CHAPTER 6

MASONRY CONSTRUCTION

6-l. Scope. This chapter prescribes methods and procedures for Quality Control testing of concrete masonry units, and mortar and grout used in the construction of buildings and other facilities. Sampling and testing shall be performed by the Contractor in accordance with the standard procedures referred to in this manual, unless otherwise specified.

6-2. Test Requirements for Masonry Units. The following tests shall be made by the Contractor on concrete masonry units, at intervals noted below:

a. Drying Shrinkage. A sample of three units shall be selected at random from units proposed for use and tested for linear shrinkage potential in accordance with ASTM C 426. Sampling and testing of the units shall be done not more than 6 months nor less than 14 days before delivery of materials to the jobsite. A minimum of one such set of drying shrinkage tests shall be made for every 10,000 or less masonry units. Additional tests shall be performed when changes are made either in the manufacturing processes or in materials used in the production of the masonry units.

b. Absorption. Moisture Content. Compressive Strength, and Unit Weight. Upon delivery of units to the jobsite and weekly thereafter, a sample of three units shall be selected at random from stockpiles and tested for compliance with ASTM C-90. When tests indicate that the masonry units do not meet the requirements of ASTM C-90, those units represented by the random sampling shall be removed from the project site at no expense to the Government.

c. Waiver of Tests. For small projects requiring less than 1,000 masonry units, tests may be waived at the discretion of the Contracting Officer, and acceptance shall be based on manufacturer's certified test report.

d. Reporting Test Results. Results of these tests, except for the compressive strength test, for which Figure 6-l is provided, shall be reported as shown in Figure 6-2.

6-3. Test Requirements for Mortar and Grout. At specified intervals shown below, the following tests shall be made of the mortar and grout during masonry construction:

a. Gradation. At weekly intervals, gradation test of the aggregates used in the mortar and grout shall be performed in accordance with ASTM C 136. The results of tests shall be compiled as shown in Figure 5-3.

b. Compressive Strenoth. At weekly intervals, compressive strengths of grout and mortar shall be tested in accordance with ASTM C 1019 and ASTM C 780 respectively. Three grout samples (3 1/2" x 3 1/2" x 7" high specimen) and three mortar samples (2" x 4" high cylinder, or 2-inch cube), shall be prepared as specified. One shall be tested at 7 days and two at 28 days. The minimum strength shall be so specified in the contract documents, and the results of tests shall be reported as shown in Figure 6-l.

COMPRESSIVE STRENGTH CONCRETE CYLINDERS

PROJECT: SRO - MATHER AFB

PERIOD COVERED: 2 SEPTEMBER 87

FEATURE: ALTER MECHANICAL SYSTEMS

CONTRACT NUMBER	CYLINDER NUMBER	DATE	AGE (days)	WEIGHT (cu-ft)	TOTAL LOAD	UNIT STRENGTH (psi)	TESTER'S INITIALS
	2"x4" CYL MORTAR						
87-C-0185	0185-0-2A				5280	1681	JB.
	2B				8953	2851	"
	2C				8970	2856	"
	8"x8"x16" BL						
87-C-0185	0185-0-16A				166,500	1400	JB
	16B				161,000	1350	"
	16C				147,000	1240	"

REMARKS

FIGURE 6-1

TEST DATA ON ABSORPTION AND MOISTURE CONDITION OF MASONRY BLOCKS

TESTED BY	DATE SAMPLED	DATE TESTED
R. JONES	1 AUG 87	1 AUG 87
PROJECT BEALE AFB SEWAGE & IND WASTE TRT	**CONTRACT NO.** 87-C-0041	**BLOCK PRODUCER** MIX ALL
BLOCK NO. 1, 2, & 3	**NOMINAL SIZE** 8" x 8" x 16"	**NO. AND SHAPE OF CORES** A-TYPE BLOCK
AGGREGATE LIGHTWEIGHT	**TYPE OF PORTLAND CEMENT** II RIVERSIDE	**ADMIXTURE** —

METHOD OF CURING

☒ IN SATURATED STEAM, AT 180 °F, AND — PSI GAGE, FOR 8 HOURS

☐ NOT IN STEAM *(Describe)* _____

METHOD OF DRYING

☒ IN OUTSIDE AIR ☐ UNDER ROOF FOR 28 DAYS

☐ IN DRYING KILN FOR _____ HOURS AT _____ °F

☐ QUICK PRESSURE RELEASE IN AUTOCLAVE ☐ WITH VACUUM

BEFORE BREAKING, BLOCK APPEARS

☐ DRY ☐ DAMP

SAMPLE

ABSORPTION AND MOISTURE TEST (ASTM C-140)

	A	B	C	D
BLOCK 1	28.13	30.34	12.18	
BLOCK 2	28.22	30.41	12.22	
BLOCK 3	28.17	30.36	12.20	

A – SAMPLED WEIGHT OF UNIT IN POUNDS
B – WET WEIGHT OF UNIT IN POUNDS
C – SUSPENDED IMMERSED WEIGHT OF UNIT IN POUNDS
D – DRY WEIGHT OF UNIT IN POUNDS

	1	2	3
ABSORPTION LB/CU FT = $\frac{B-D}{B-C}$ X 62.4	11.37	11.46	11.37
MOISTURE CONTENT % OF TOTAL ABSORPTION = $\frac{A-D}{B-D}$ X 100	33.23	34.43	33.84
UNIT WEIGHT LB/CU FT = $\frac{D}{B-C}$ X 62.4	92.88	92.87	92.95

AVERAGE ANNUAL RELATIVE HUMIDITY 70

MOISTURE CONTENT, MAXIMUM % OF TOTAL ABSORPTION (AVG ANNUAL R.H.) (ASTM C-90)

LINEAR SHRINKAGE AS FOUND .041	75+	75 TO 50	50-
0.03 OR LESS	45	40	35
0.03 TO 0.045	40	(35)	30
0.045 OR OVER	35	30	25

MOISTURE CONDITION TEST (ASTM C-427)

TEST STARTED AT _____ HR. _____ MIN.

AVG REL HUMIDITY OF MONTH OF DELIVERY _____

TIME *(Mins)*	RELATIVE HUMIDITY INDICATED %	RELATIVE HUMIDITY ACTUAL %	TEMPERATURE IN CONT. °F	TEMPERATURE IN ROOM °F
0				
5				
10				
15				
20				
25				
30				
35				
40				
45				
50				
55				
60				
65				
70				
75				
80				
85				
90				

RESULTS

FINAL ACTUAL *(CORRECTED)* REL. HUM. _____

FINAL TEMPERATURE IN CONTAINER IS _____

Values at zero time are the relative humidity and temperature of room air indicated by the hygrometer and thermometer in the cover just before it was placed in the container.

FIGURE 6-2

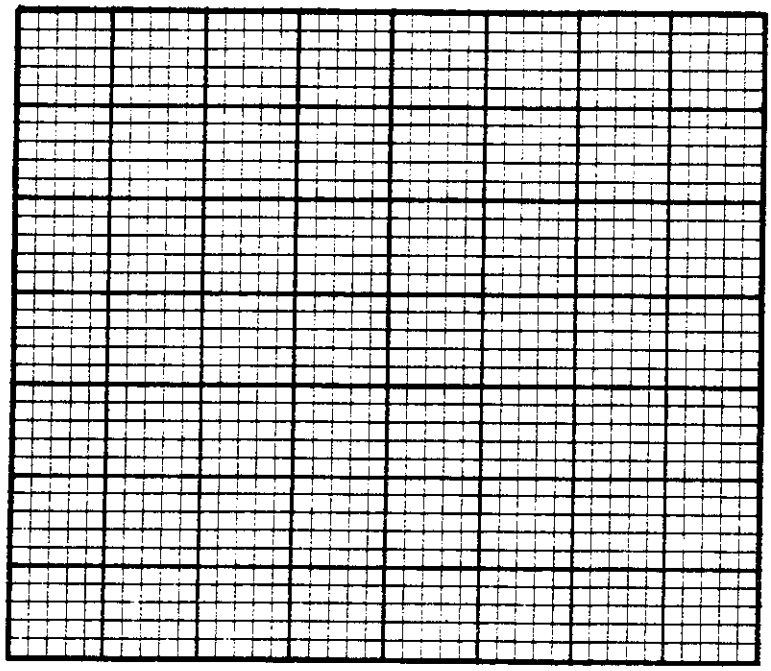
APPENDIX A

MASTER TEST FORMS

PROJECT	CORPS OF ENGINEERS _____ LABORATORY COMPACTION-MOISTURE DENSITY DETERMINATIONS	DATE
CONTRACT NO		SOURCE OF MATERIAL
TEST NO		TEST METHOD

DIA. OF MOLD *(in.)*	NUMBER OF LAYERS	NUMBER OF BLOWS PER LAYER	WEIGHT OF TAMPER
HEIGHT OF DROP *(in)*	MAXIMUM PARTICLE SIZE	HEIGHT OF SOIL SAMPLE *(in)*	HAND TAMPER ☐ MECHANICAL TAMPER ☐

A. WATER ADDED C.C. OR PERCENT						
B. MOLD NUMBER						
C. WT. OF WET SOIL + MOLD						
D. WT. OF MOLD						
E. WT. OF WET SOIL (C-D)						
F. VOL. OF SOIL SAMPLE (CU. FT.)						
G. $\frac{E}{F}$ = WET DENSITY LB/CU.FT.						
H. CONTAINER NO						
I. WT. OF WET SOIL + TARE						
J. WT. OF DRY SOIL + TARE						
K. WT. OF WATER (I-J)						
L. WT. OF TARE						
M. WT. OF DRY SOIL (J-L)						
N. WATER CONTENT $\frac{K}{M}$ %						
P. DRY UNIT WT. $\left(\frac{G}{100 + N}\right)$ = LB/CU.FT.						



TEST RESULTS	
OPT. WATER CONTENT, 0/0	
MAXIMUM DRY DENSITY, LB/CU.FT.	

CLASSIFICATION OF SAMPLE _____

LIQUID AND PLASTIC LIMITS:
LL._____ PL._____ PI._____

SYMBOL FROM PLASTIC CHART

REMARKS: _____

TESTED BY	CHECKED BY
SUBMITTED BY	

SPD FORM 56
1 OCT 72

MECHANICAL ANALYSIS DATA

SITE	HOLE	SAMPLE NO.
		DEPTH
DATE RECEIVED	DATE COMPLETED	FOUNDATION
		BORROW

SIEVE NO.	DIAMETER PARTICLES INCHES	DIAMETER PARTICLES MM	WEIGHT RETAINED GM.	% RET OF TOTAL SAMPLE	% PASS. TOTAL SAMPLE	CUMULATIVE % OF TOTAL RETAINED	CUMULATIVE % OF TOTAL PASSING	
3"	3.0							GRAVEL
2"								
1½"								
1"								
3/4"								
1/2"								
3/8"								
#4								
#8								
PAN								
TOTAL								
10								SAND
16								
30								
40								
50								
60								
100								
200								
270								
PAN								
TOTAL								

INITIAL WT. OF PARTIAL SAMPLE _____ GM

GUM ARABIC ADDED _____ cc

HYD. PEROXIDE ADDED

LIQUID LIMIT, W_L

RUN NUMBER						
TARE NUMBER						
A. WEIGHT OF WET SOIL + TARE						
B. WEIGHT OF SOIL + TARE						
C. WEIGHT OF WATER, W_W (A-B)						
D. WEIGHT OF TARE						
E. WEIGHT OF DRY SOIL, W_S (B-D)						
WATER CONTENT, $w = \left(\frac{W_W}{W_S} \times 100\right)$						
NUMBER OF BLOWS						

W_L	W_P	I_P (W_L - W_P)

PLASTIC LIMIT, W_P

RUN NUMBER					NATURAL WATER CONTENT
TARE NUMBER					
F. WEIGHT OF WET SOIL + TARE					
G. WEIGHT OF DRY SOIL + TARE					
H. WEIGHT OF WATER, W_W (F. - G.)					
I. WEIGHT OF TARE					
J. WEIGHT OF DRY SOIL, W_S (G. - I.)					
WATER CONTENT, $w = \left(\frac{W_W}{W_S} \times 100\right)$					
PLASTIC UNIT, I_P (AVERAGE w)					

REMARKS

TECHNICIAN *(SIGNATURE)*	COMPUTED BY *(SIGNATURE)*	CHECKED BY *(SIGNATURE)*

CORPS OF ENGINEERS

_____ LABORATORY

FIELD DENSITY

PROJECT	DATE
FEATURE	SAMPLE TAKEN FROM TO
CONTRACT NO.	ELEVATION TOP OF SAMPLE
LOCATION	DEPTH TO SAMPLE TOP BOTTOM
SOURCE OF MATERIAL	NO. ROLLER PASSES
DESCRIPTION	DENSITY NO.
	TESTED BY

GROUND SURFACE CALIBRATION

A. CONTAINER NUMBER _____

B. WT. INITIAL CONTAINER + SAND _____ LBS

C. WT. AFTER CONTAINER + SAND _____ LBS

D. WT. SAND (B - C) USE FOR K. _____ LBS

DENSITY DETERMINATION

E. WET SAMPLE + CONTAINER _____ LBS

F. WT. CONTAINER _____ LBS

G. WT. WET SAMPLE (E. - F.) _____ LBS

H. SAND + CONTAINER START (FROM C.) _____ LBS

I. SAND + CONTAINER FINISH _____ LBS

J. SAND IN HOLE + CONE (H. - I.) _____ LBS

K. SAND IN LOWER CONE + PLATE (D.) _____ LBS

L. SAND IN HOLE ONLY (J. - K.) _____ LBS

M. DENSITY OF SAND (5.) _____ LBS

N. VOLUME OF HOLE $\left(\frac{L.}{M.}\right)$ _____ CU-FT

P. UNIT WET WT. SAMPLE $\left(\frac{G.}{N.}\right)$ _____ LB/CU-FT

R. UNIT DRY WT. SAMPLE $\left(\frac{P}{100 + V}\right)$ _____ LB/CU-FT

MOISTURE CONTENT

S. CONTAINER NUMBER _____

T. WT. MOIST. SAMPLE + CONTAINER _____ LBS

U. WT. DRY SAMPLE + CONTAINER _____ LBS

V. WT. OF WATER (T. - U.) _____ LBS

W. WT. OF CONTAINER _____ LBS

X. WT. OF DRY SAMPLE (U. - W.) _____ LBS

Y. PERCENT MOISTURE $\left(\frac{V.}{X.}\right)$ _____ %

CALIBRATION OF DENSITY SAND

1. WT. OF SAND + TARE _____ LBS
2. WT. OF TARE _____ LBS
3. WT. OF SAND _____ LBS
4. VOL. OF CONTAINER _____ CU-FT
5. WT. CU-FT OF SAND (3/4) _____ LBS

COMPARISON OF FIELD DENSITY WITH MAXIMUM DENSITY

6. SEE LAB. COMPACTION TEST NO. _____
7. MAXIMUM DENSITY (LAB. COMP) _____ LB/CU-FT
8. DEGREE OF COMPACTION $\left(\frac{R.}{7.}\right)$ _____ %
9. COMPACTION REQUIRED _____ %
10. OPTIMUM MOISTURE _____ %
11. WT. RETAINED NO. 4 _____ LBS _____ %
12. WT. PASSING NO. 4 _____ LBS _____ %
13. TOTAL WT. _____ LBS _____

ROCK CORRECTION

(Pycnometer or chart method optional)

AA. WT. IN AIR (SAT. SUR. DRY) _____ GMS

BB. WT. IN WATER _____ GMS

CC. VOL. ROCK $\frac{AA. - BB.}{28.306}$ _____ CU-FT

DD. CORRECTED WT. SAMPLE G - $\frac{AA.}{453.6}$ _____ LBS

EE. CORRECTED VOL. HOLE $\frac{L}{H.}$ - CC _____ CU-FT

FF. CORRECTED UNIT WT. SAMPLE $\frac{DD.}{EE.}$ _____ LBS/CU-FT

COMPUTED BY

CHECKED BY

SUBMITTED BY

SPD FORM 1 MAY 81 312-R REPLACES SPD FORM 312, 1 OCT 80

NUCLEAR FIELD DENSITY TEST WORKSHEET

PROJECT _____ CONTRACT NO. _____ DATE _____

LOCATION _____ CONTRACT DRAWING(S) _____ TIME _____

SOURCE _____ SPECIFICATION SECTION(S) _____ ENGINEERING TECHNICIAN _____

SUPERVISING TECHNICIAN _____

TEST NO.	LOCATION & FEATURE	DEPTH OR ELEVATION	PROCTOR DENSITY PCF	O.M.C. %	DRY DENSITY PCF	MOISTURE CONTENT %	COMPACTION ACT. %	COMPACTION REQ. %	SAMPLE NO. AND SOIL TYPE (ASTM D 2487)

LABORATORY MANAGER _____

SIEVE ANALYSIS

Date _____

Project _____

Boring No. _____ Sample No. _____

Total wt in grams of sample, W_s = | Wt in grams of material > No. 4 sieve =

Sieve Openings		U. S. Standard Sieve Size or Number	Weight Retained in grams	Percent Retained		Percent Finer by Weight
Inches	Millimeters			Partial	Total	
3.00		3-in.				
2.00		2-in.				
1.50		1-1/2-in.				
1.00	25.4	1-in.				
0.750	19.1	3/4-in.				
0.500	12.7	1/2-in.				
0.375	9.52	3/8-in.				
0.250	6.35	No. 3				
0.187	4.76	No. 4				
		Pan				
0.132	3.36	No. 6				
0.094	2.38	No. 8				
0.079	2.00	No. 10				
0.047	1.19	No. 16				
0.033	0.84	No. 20				
0.023	0.59	No. 30				
0.0165	0.42	No. 40				
0.0117	0.297	No. 50				
0.0083	0.210	No. 70				
0.0059	0.149	No. 100				
0.0041	0.105	No. 140				
0.0029	0.074	No. 200				
		Pan				
Total weight in grams						

Partial percent retained = $\frac{\text{wt in grams retained on a sieve}}{\text{wt in grams of sample used for a given series of sieves}} \times 100$

Total percent retained = $\frac{\text{wt in grams retained on a sieve}}{\text{total wt in grams of oven-dry sample}} \times 100$

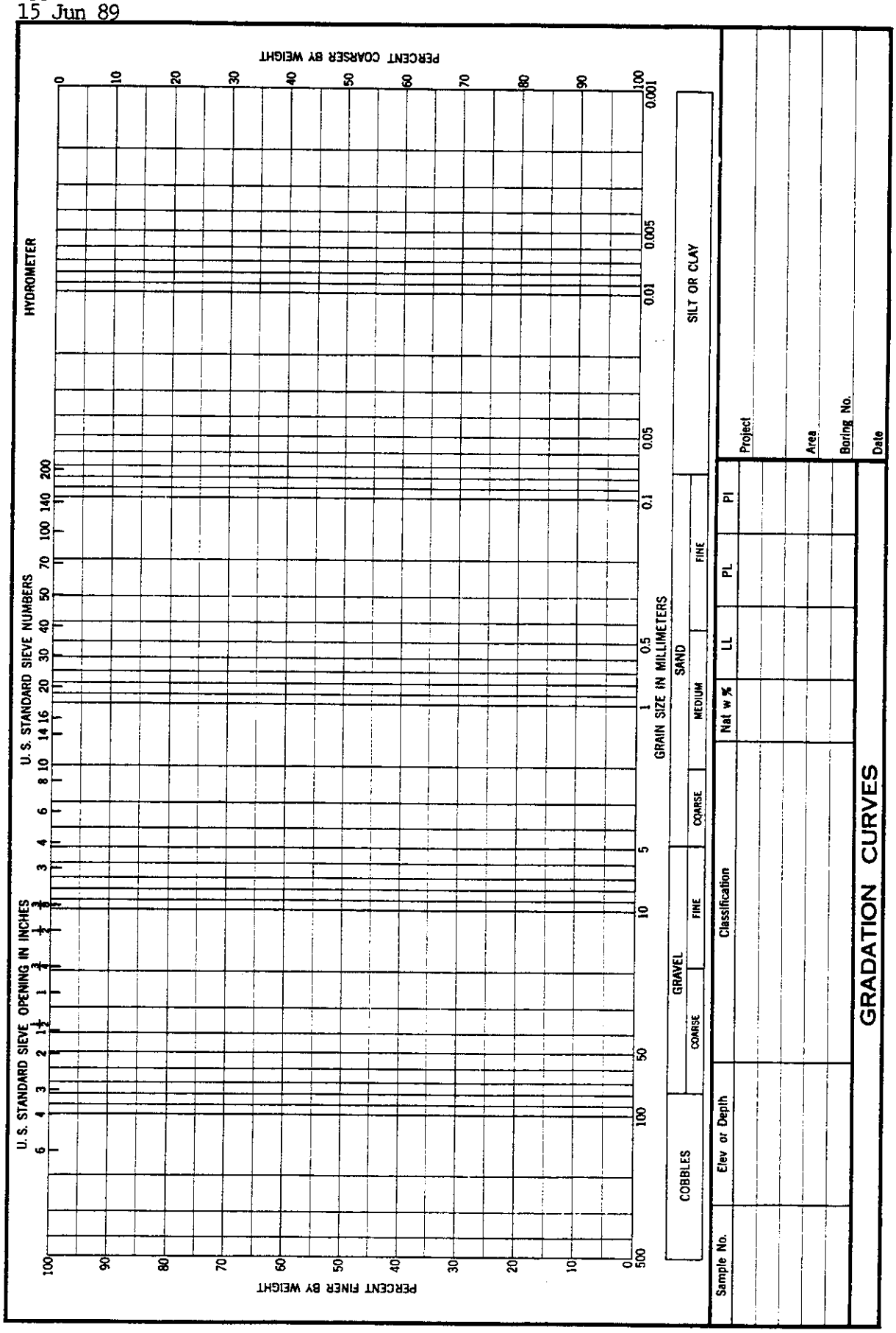
For an individual sieve, the percent finer by weight = percent finer than next larger sieve - percent retained on individual sieve

Remarks

Technician _____ Computed by _____ Checked by _____

ENG FORM 1 JUN 65 3841

PLATE V-1


PERCENT COARSER BY WEIGHT
HYDROMETER
U. S. STANDARD SIEVE NUMBERS
U. S. STANDARD SIEVE OPENING IN INCHES
GRAIN SIZE IN MILLIMETERS
COBBLES
GRAVEL
COARSE
FINE
SAND
COARSE
MEDIUM
FINE
SILT OR CLAY
PERCENT FINER BY WEIGHT
Sample No.
Elev or Depth
Classification
Nat w %
LL
PL
PI
Project
Area
Boring No.
Date
GRADATION CURVES
ENG FORM 1 MAY 63 2087

ATTERBERG LIMITS DETERMINATION

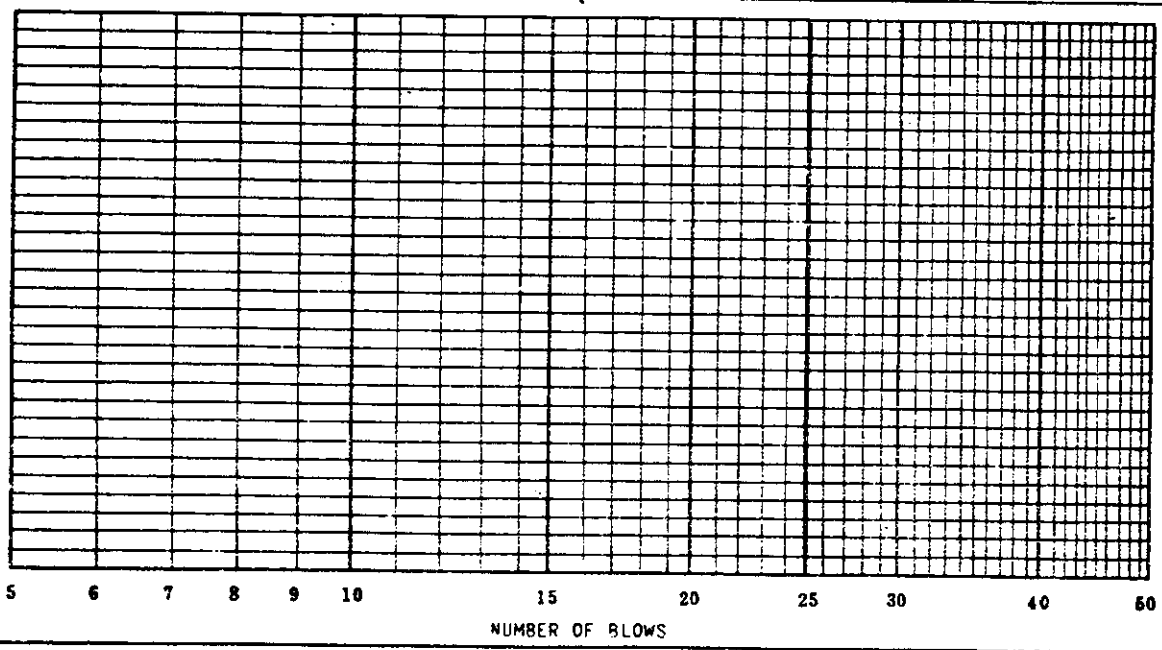
DATE

PROJECT	EXCAVATION NUMBER	SAMPLE NUMBER

LIQUID LIMIT, w_L

RUN NUMBER						
TARE NUMBER						
A. WEIGHT OF WET SOIL + TARE						
B. WEIGHT OF DRY SOIL + TARE						
C. WEIGHT OF WATER, W_w (A.-B.)						
D. WEIGHT OF TARE						
E. WEIGHT OF DRY SOIL, W_s (B.-D.)						
WATER CONTENT, $w=(\frac{W_w}{W_s} \times 100)$						
NUMBER OF BLOWS						

w_L	w_P	I_p (w_L-w_P)



PLASTIC LIMIT, w_P

					NATURAL WATER CONTENT
RUN NUMBER					
TARE NUMBER					
F. WEIGHT OF WET SOIL + TARE					
G. WEIGHT OF DRY SOIL + TARE					
H. WEIGHT OF WATER, W_w (F.-G.)					
I. WEIGHT OF TARE					
J. WEIGHT OF DRY SOIL, W_s (G.-I.)					
WATER CONTENT, $w=(\frac{W_w}{W_s} \times 100)$					
PLASTIC LIMIT, I_p (Average w)					

REMARKS

TECHNICIAN (Signature)	COMPUTED BY (Signature)	CHECKED BY (Signature)

DD FORM 1 AUG 57 1209

U. S. Government Printing Office: 1982-564-036/0419

SPECIFIC GRAVITY TESTS

Date _____

Project _____

Boring No. _____

SPECIFIC GRAVITY OF SOLIDS (G_s)

Sample or Specimen No.						
Flask No.						
Temperature of water and soil, T, °C						
Dish No.						
Weight in grams	Dish + dry soil					
	Dish					
	Dry soil	W_s				
	Flask + water at T, °C	W_{bw}				
	$W_s + W_{bw}$					
	Flask + water + immersed soil	W_{bws}				
	Displaced water, $W_s + W_{bw} - W_{bws}$					
Correction factor		K				
$(W_s K) \div (W_s + W_{bw} - W_{bws})$		G_s				

APPARENT (G_a) AND BULK (G_m) SPECIFIC GRAVITY

Sample or Specimen No.						
Temperature of water and soil, T, °C						
Weight in grams	Tare + saturated surface-dry soil					
	Tare					
	Saturated surface-dry soil	B				
	(Wire basket + soil) in water					
	Wire basket in water					
	Saturated soil in water	C				
	Tare + dry soil					
	Tare					
	Dry soil	A				
Correction factor		K				
$(AK) \div (A - C)$	(Apparent)	G_a				
$(AK) \div (B - C)$	(Bulk)	G_m				

Remarks _____

Technician _____ Computed by _____ Checked by _____

ENG FORM 3840 1 JUN 65 EM 1110-2-1906 D41511 PLATE IV-1

DAILY PLANT AND LABORATORY REPORT BITUMINOUS PAVEMENT

PROJECT	CONT. NO.	DATE

TIME OR SHIFT						
SAMPLE NO.	SPEC.					
AGG. TEMP.						
ASPHALT TEMP.						
DISCHARGE TEMP.						
ROLLING TEMP.						
UNIT WT. PCF						
STABILITY						
FLOW						
VOIDS TOTAL MIX						
VOIDS FILLED W/ASPHALT						
ASPHALT (EXTRACTED)						
GRADATION OF AGGREGATE PERCENT PASSING						
	NO.					
	NO.					
	NO.					
	NO.					
	NO.					
	NO.					
	NO.					
GRADATION OF HOT BINS PERCENT PASSING						
	NO.					
	NO.					
	NO.					
	NO.					
	NO.					
	NO.					
	NO.					

DATA FROM PAVEMENT CORES

SAMPLE NO.						
DATE PAVEMENT PLACED						
THICKNESS (INCHES)						
UNIT WT. PCF						
REL. DENS.						
VOIDS						
VOIDS FILLED W/ASPHALT						

BATCH PROPORTIONS

BIN NO. 1		TYPE OF PLANT	
BIN NO. 2		TONS PLACED THIS DATE	
BIN NO. 3		GRADE OF ASPHALT	
BIN NO. 4		REMARKS	
ASPHALT			
TOTAL	100.0		

SIGNED BY _____

PROJECT ENGINEER

SPD FORM 59
1 MAR 80

(Previous editions are obsolete)

CORPS OF ENGINEERS

EXTRACTION TEST
HOT MIX ASPHALTIC CONCRETE

TESTED BY

LABORATORY

PROJECT	LAB NO	DATE
LOCATION OF SAMPLE	FIELD NO	TESTED BY

UNIT WEIGHT

A. WEIGHT IN AIR	C. LOSS IN WEIGHT
B. WEIGHT IN WATER	D. UNIT WEIGHT (A/C)

ASPHALT CONTENT

A. WT. BEFORE EXTRACTION	F. VOL. IN ML OF BITUMEN SOL.
B. WT. AFTER EXTRACTION	G. WT. OF ASH/100 ML
C. WT. OF FILTER AND AGG.	H. TOTAL WT. OF ASH $(\frac{F \times G}{100})$
D. INITIAL WT. OF FILTER	I. TOTAL WT. EXTRACTED AGG. (B + E + H)
E. WT. OF AGG. RETAINED (C-D)	J. PER CENT ASPHALT $\frac{100\ (A - B - E) - FG}{A}$

GRADING OF AGGREGATE

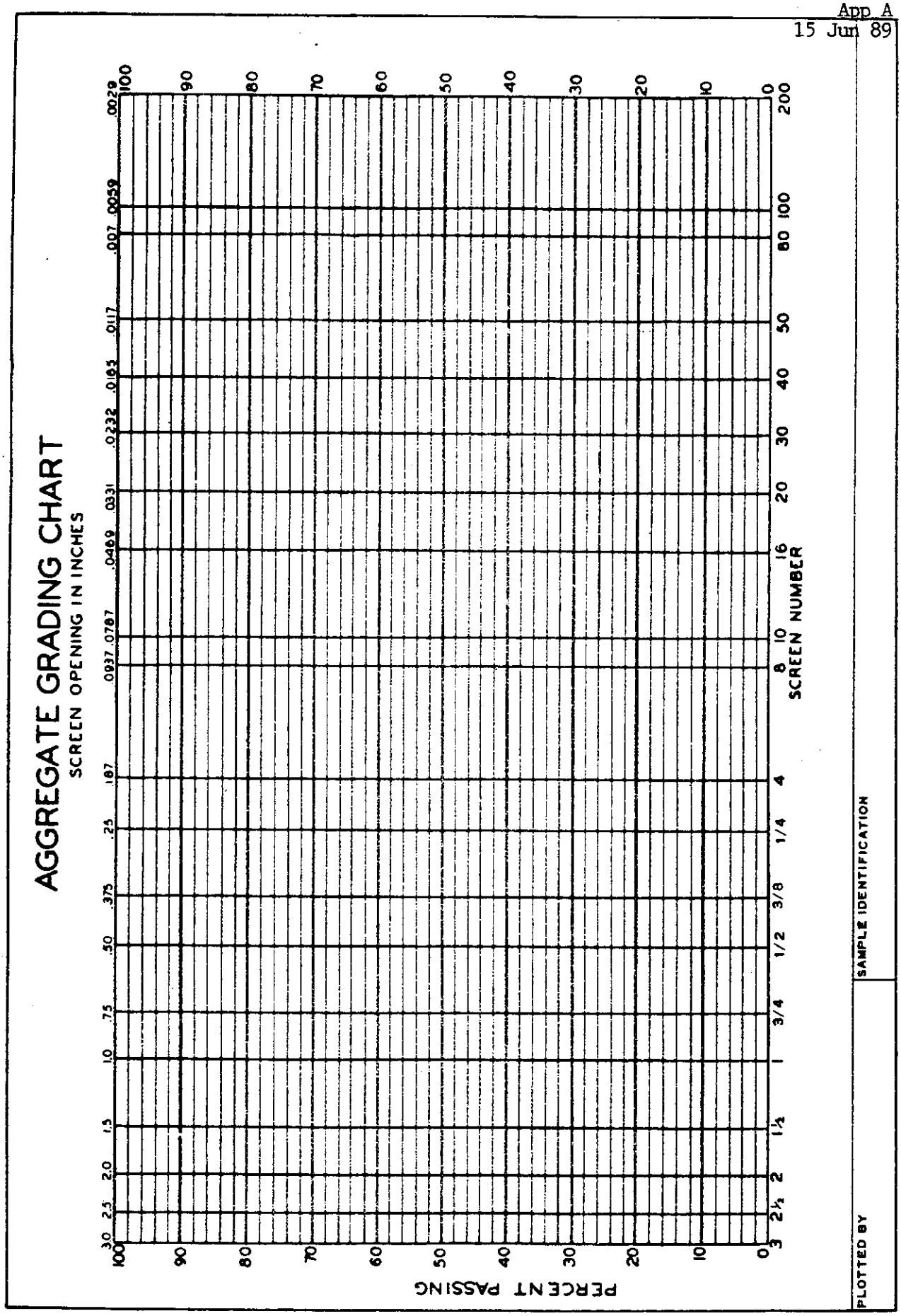
DRY WEIGHT OF SAMPLE BEFORE TEST (1)_____GMS.

SIEVE SIZE	WEIGHT RETAINED	CUMULATIVE WT. RETAINED	CUMULATIVE PER CENT RETAINED	PER CENT PASSING	

REMARKS

TECHNICAN *(Signature)*	COMPUTED BY *(Signature)*	SUBMITTED BY *(Signature)*

SPD FORM 55
1 OCT 72


AGGREGATE GRADING CHART
SCREEN OPENING IN INCHES
.0029 .0059 .007 .0117 .0165 .0232 .0331 .0469 .0787 .0937 .187 .25 .375 .50 .75 1.0 1.5 2.0 2.5 3.0
100 90 80 70 60 50 40 30 20 10 0
200 100 80 50 40 30 20 16 10 8 4 1/4 3/8 1/2 3/4 1 1½ 2 2½ 3
SCREEN NUMBER
PERCENT PASSING
SAMPLE IDENTIFICATION
PLOTTED BY
WES FORM 886
AUGUST 55

SIEVE ANALYSIS

JOB NO.:	PROJECT:	DATE:

DRY GRADATION

SAMPLE NO.				SAMPLE NO.			
U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS	U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS
3/4				3/4			
1/2				1/2			
3/8				3/8			
NO. 4				NO. 4			
NO. 8				NO. 8			
NO. 16				NO. 16			
NO. 30				NO. 30			
NO. 50				NO. 50			
NO. 100				NO. 100			
NO. 200				NO. 200			
-200				-200			
TOTAL				TOTAL			
WEIGHT ORIGINAL SAMPLE				WEIGHT ORIGINAL SAMPLE			

WASHED GRADATION

SAMPLE NO.				SAMPLE NO.			
U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS	U.S. STAND. SIEVE NO.	WEIGHT RETAINED	% RETAINED	% PASS
3/4				3/4			
1/2				1/2			
3/8				3/8			
NO. 4				NO. 4			
NO. 8				NO. 8			
NO. 16				NO. 16			
NO. 30				NO. 30			
NO. 50				NO. 50			
NO. 100				NO. 100			
NO. 200				NO. 200			
-200 (T)				-200 (T)			
TOTAL				TOTAL			

(A) WEIGHT ORIGINAL SAMPLE _____ GM
(B) WEIGHT AFTER WASHED _____ GM
(C) WASH LOSS (A - B) _____ GM
(S) -200 FROM SIEVING _____ GM
(T) TOTAL -200 C + S _____ GM
USE "T" TO CALCULATE PERCENTAGES

(A) WEIGHT ORIGINAL SAMPLE _____ GM
(B) WEIGHT AFTER WASHED _____ GM
(C) WASH LOSS (A - B) _____ GM
(S) -200 FROM SIEVING _____ GM
(T) TOTAL -200 C + S _____ GM
USE "T" TO CALCULATE PERCENTAGES

TESTED BY:	COMPUTED BY:	CHECKED BY:

WES FORM NO. 1505
SEPT 65

MARSHALL METHOD - COMPUTATION OF PROPERTIES OF ASPHALT MIXTURES

DATE OF COMPUTATION

JOB NUMBER | PROJECT | DESCRIPTION OF BLEND

SPECIMEN NUMBER	ASPHALT CEMENT (Percent)	THICKNESS (Inches)	WEIGHT (Grams)		VOLUME CC	SPECIFIC GRAVITY		AC BY VOLUME (Percent)	VOIDS (Percent)		UNIT WEIGHT TOTAL MIX (Lb./Cu.Ft.)	STABILITY (Pounds)		FLOW UNITS OF 1/100 IN.
			IN AIR	IN WATER		ACTUAL	THEORIZED		TOTAL MIX	FILLED		MEASURED	CONVERTED	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
					(d - e)	$\frac{(d)}{(f)}$		$\frac{(b \times g)}{(Sp.Gr.\ of\ AC)}$	$(100 - 100\frac{(g)}{(h)})$	$\frac{(i)}{(i + j)}$	(g x 62.4)		*	
												✓		

* From conversion table

COMPUTED BY

CHECKED BY

DD FORM 1 DEC 69 1218

PREVIOUS EDITION OF THIS FORM IS OBSOLETE.

US ARMY AG PUBLICATIONS CENTER
BALTIMORE - 1985

MARSHALL METHOD - COMPUTATION OF PROPERTIES OF ASPHALT MIXTURES

DATE OF COMPUTATION

JOB NUMBER | PROJECT | DESCRIPTION OF BLEND

SPECIMEN NUMBER	ASPHALT CEMENT (Percent)	THICKNESS (Inches)	WEIGHT (Grams)		VOLUME CC	SPECIFIC GRAVITY		AC BY VOLUME (Percent)	VOIDS (Percent)		UNIT WEIGHT TOTAL MIX (Lb./Cu.Ft.)	STABILITY (Pounds)		FLOW UNITS OF 1/100 IN.
			IN AIR	IN WATER		ACTUAL	THEORIZED		TOTAL MIX	FILLED		MEASURED	CONVERTED	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
					(d - e)	$\frac{(d)}{(f)}$		$\frac{(b \times g)}{(Sp.Gr.\ of\ AC)}$	$(100 - 100\frac{(g)}{(h)})$	$\frac{(i)}{(i + j)}$	(g x 62.4)		*	

* From conversion table

COMPUTED BY | CHECKED BY

DD FORM 1 DEC 65 1218 PREVIOUS EDITION OF THIS FORM IS OBSOLETE.

MAXIMTJM THEORETICAL SPECIFIC GRAVITY
ASPHALT CONTENT
ASTM D 2041
METHOD C

CONTRACT NUMBER: _____

DATE SAMPLED: _____

DATE TESTED: _____

PROJECT:

A = Dry Weight of Sample (g)
D = Weight of Pycnometer + Water (77°F) (g)
E = Weight of Pycnometer + Sample + Water (g)
S = SSD Weight of Sample (g) - Substitute for 'A' in Denominator of Equation if Dry Back Method is Used

$$SG = \frac{A}{A + D - E}$$

OIL CONTENT_____
A = _____
D = _____
SG = _____

Water Temp (°F)_____
E = _____
s = _____
*SG (Corr for Temp) = _____

OIL CONTENT_____
A = _____
D = _____
SG = _____

Water Temp (°F)_____
E = _____
s = _____
*SG (Corr for Temp) = _____

OIL CONTENT_____
A = _____
D = _____
SG = _____

Water Temp (°F)_____
E = _____
s = _____
*SG (Corr for Temp) = _____

OIL CONTENT_____
A = _____
D = _____
SG = _____

Water Temp (°F)_____
E = _____
s = _____
*SG (Corr for Temp) = _____

BITUMINOUS MIX DESIGN - AGGREGATE BLENDING

PROJECT	JOB	DATE
		AGGREGATE GRADATION NUMBER

GRADATION OF MATERIAL

SIEVE SIZE (To be entered by Technician): →												
MATERIAL USED	PERCENT PASSING											
DESIRED:												

COMBINED GRADATION FOR BLEND - TRIAL NUMBER _____

SIEVE SIZE (To be entered by Technician): →												
MATERIAL USED	% USED	PERCENT PASSING											
BLEND:													
DESIRED:													

COMBINED GRADATION FOR BLEND - TRIAL NUMBER _____

SIEVE SIZE (To be entered by Technician): →												
MATERIAL USED	% USED	PERCENT PASSING											
BLEND:													
DESIRED:													

DD FORM 1 DEC 68 1217 PREVIOUS EDITION OF THIS FORM IS OBSOLETE.

CESPK PAM 415-1-2
App A
15 Jun 89

COMBINED GRADATION FOR BLEND - TRIAL NUMBER _____

SIEVE SIZE (To be entered by Technician): →												
MATERIAL USED	% USED	PERCENT PASSING										
BLEND:												
DESIRED:												

COMBINED GRADATION FOR BLEND - TRIAL NUMBER _____

SIEVE SIZE (To be entered by Technician): →												
MATERIAL USED	% USED	PERCENT PASSING										
BLEND:												
DESIRED:												

REMARKS

TECHNICIAN (Signature)	COMPUTED BY (Signature)	CHECKED BY: (Signature)

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

CONCRETE FIELD CONTROL

PROJECT	DATE
CONTRACTOR	CONTRACT NO.
LOCATION OF PLACEMENT	CLASS OF CONCRETE

SPECIFICATIONS:

C.F._____ W/C_____ GAL/SACK SLUMP RANGE_____

TIME	WATER ADDED GALS.	SLUMP	% AIR	PLASTIC UNIT WT.	MIX TEMP.	CYLINDERS *(No. and Comments)*

REMARKS

TESTED BY	SUBMITTED BY

SPD FORM 58
1 OCT 72

CONCRETE CONTROL DATA

PROJECT NAME		CONTRACT NO.
CONCRETE PRODUCER	BATCH PLANT LOCATION	SPECIMEN TYPE: ☐ CYLINDER ☐ BEAM
LOCATION OF PLACEMENT		
CEMENT TYPE: BRAND	SK/CU YD / MIX NO.	AIR ENTRAINMENT ADMIXTURE: BRAND
AGGREGATE PRODUCER	SAND SOURCE	ROCK SOURCE
STRENGTH REQUIREMENT _____PSI AT _____DAYS	BATCH TICKET NO. / TRUCK NO.	DATE SPECIMENS MOLDED

FIELD MIX DATA

AGG MOIST % a	MATERIAL b	BATCH WEIGHTS c	FREE MOIST IN LBS d	COMPUTED SSD WEIGHT e	SPECIFIC GRAVITY f	ABSOLUTE VOLUME g	QUANTITIES PER CU YD h	DESIGN WEIGHT i
		FROM BATCH TICKET	$\frac{a}{100+a} \times c$	c-d	FROM MIX DESIGN	$\frac{e}{f(62.4)}$	* $\frac{e}{\text{YDS BATCHED}}$	FROM MIX DESIGN
	CEMENT							
	SAND							
	COARSE AGG # 1 SIZE NO.							
	COARSE AGG #2 SIZE NO.							
	ADMIXTURE TOTAL OZ							
WATER IN AGGREGATES (ADD COL d)								
WATER ADDED AT BATCH PLANT (LBS)			TOTAL WATER				TIME SPECIMENS MOLDED	
WATER ADDED AT JOSITE (LBS)				1.00				

CONC. TEM	SLUMP	AIR CONTENT	$\frac{\text{TOTAL VOLUME OF BATCH (add col. g)}}{27 \text{ (less .27 for each percent air)}}$ = _____ CU YDS

UNIT WEIGHT OF CONCRETE LBS/CU FT	SPECIMENS MADE BY	W/C BY WEIGHT (ACTUAL) $\frac{\text{TOTAL WATER}}{\text{CEMENT WEIGHT (COL c)}}$ =	W/C FROM MIX DESIGN
DATE/TIME SPECIMENS PLACED IN CURING TANK	TESTING AGENCY	SPECIMENS TESTED BY	

REMARKS

* FROM BATCH TICKET

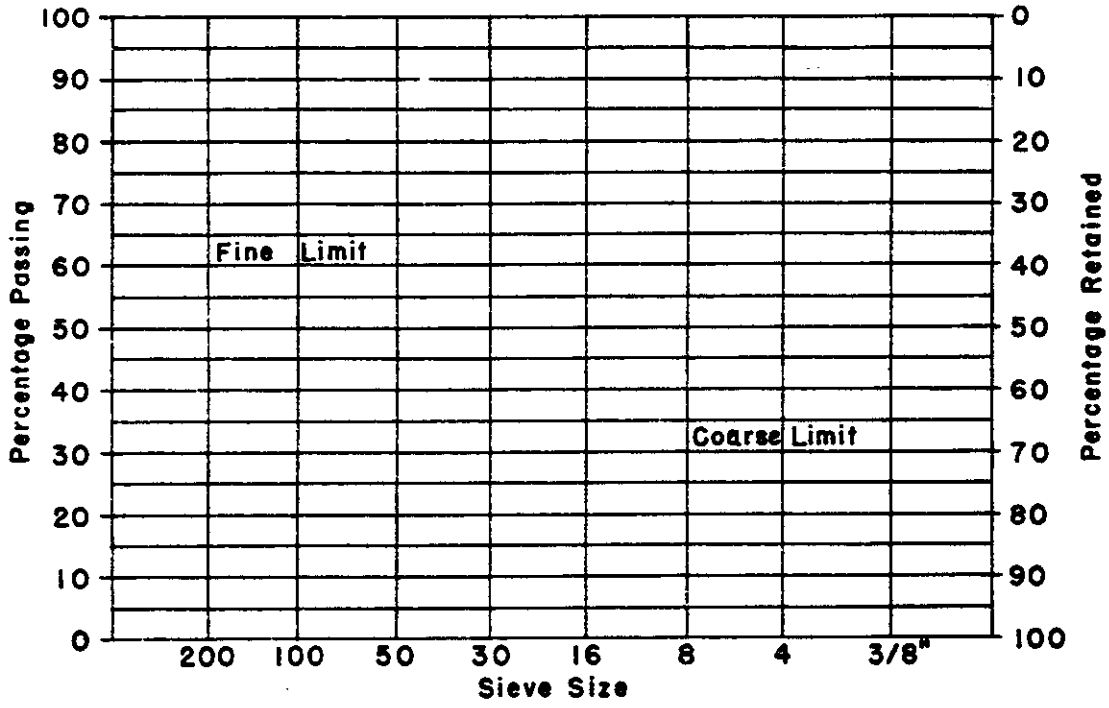
RESULTS OF LABORATORY TESTS

FIELD NO.	BREAK DATE	AGE DAYS	TOTAL LOAD LBS	UNIT STR. LBS/SQ. IN	REMARKS

SAND TEST

Sampled by _____ Lab. No._____

Remarks _____ Date _____



Sieve Size	Ret. on Each Sieve: Grams	%	Cum. Ret. %	Cum. Pass. %
3/8"				
NO. 4				
" 8				
" 16				
" 30				
" 50				
"100				
"200				
Pan				

F.M._____ Moisture_____% as rec'd

Wt./ ft.^{3}: Std._____Lbs. Loose_____Lbs.

Organic Matter:_____ _____
Color No.

Structural Strength:_____

Sp. Gr.:_____ Voids:_____%

Silt & Clay_____% Soundness_____%

Tested by:_____ Date:_____

SPK FORM 1 JUL 82 217

AGGREGATE GRADING

PROJECT	SPEC NUMBER	LAB NUMBER	TESTED BY	DATE
CONTRACTOR	CONTRACT NUMBER	SOURCE	AGGREGATE PRODUCER	

COARSE AGGREGATE SIEVE ANALYSIS

FRACTION SIZE (3/4"-NO 4) _____ WEIGHT OF SAMPLE _____

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	CUMULATIVE PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPEC. LIMITS
1 1/2"					
1"					
3/4"					
1/2"					
3/8"					
NO. 4					
NO. 8					

FRACTION SIZE (1 1/2"-3/4") _____ WEIGHT OF SAMPLE _____

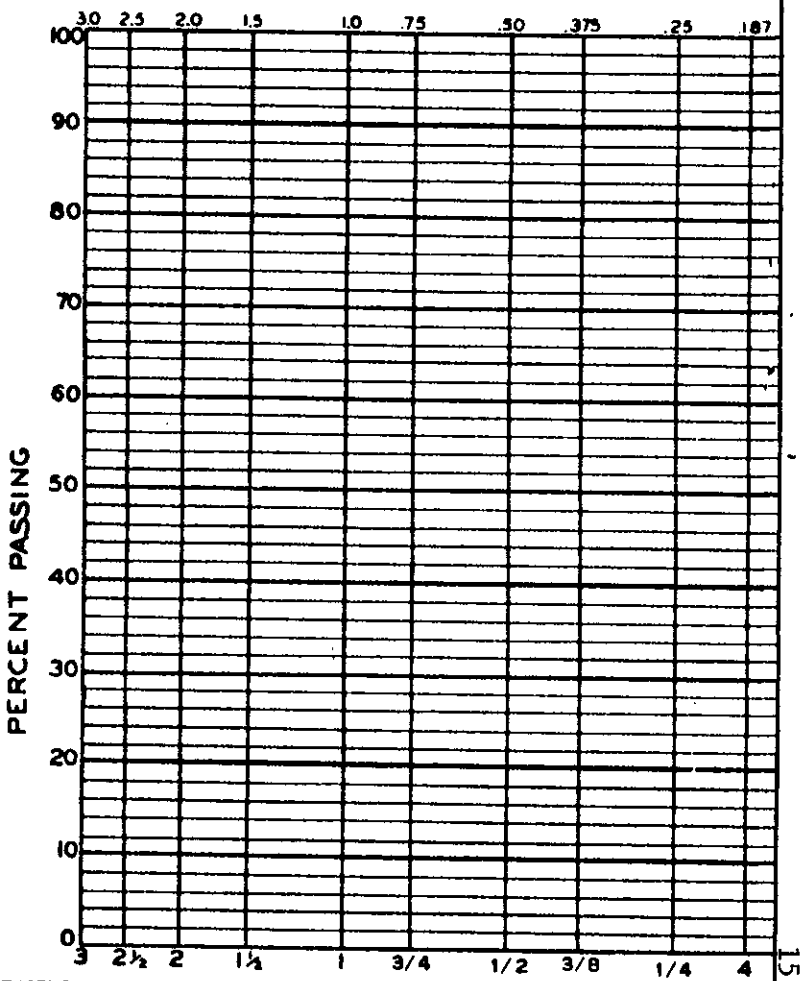
SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	CUMULATIVE PERCENT RETAINED	CUMULATIVE PERCENT PASSING	SPEC. LIMITS
2" or 3"					
1 1/2"					
1"					
3/4"					
3/8"					
NO. 4					
#8 or PAN					

CALCULATION OF COMBINED GRADATION

SIZE	% in mix	Percent Passing 2"	1 1/2"	1"	3/4"	3/8"	#4	#8
Combined grading								

COARSE AGGREGATE GRADING CHART

CRD NO. _____ OR ASTM _____



REMARKS

SPD FORM 54
1 OCT 72

COMPRESSIVE STRENGTH CONCRETE CYLINDERS

PROJECT	PERIOD COVERED

FEATURE

CONTRACT NUMBER	CYLINDER NUMBER	DATE	AGE (days)	WEIGHT (cu-ft)	TOTAL LOAD	UNIT STRENGTH (psi)	TESTER'S INITIALS

REMARKS

SPK FORM 421 *(This form replaces SPD 33 1 Oct 72 which has been cancelled.)*

TEST DATA ON ABSORPTION AND MOISTURE CONDITION OF MASONRY BLOCKS

TESTED BY	DATE SAMPLED	DATE TESTED
PROJECT	CONTRACT NO.	BLOCK PRODUCER
BLOCK NO.	NOMINAL SIZE	NO. AND SHAPE OF CORES
AGGREGATE	TYPE OF PORTLAND CEMENT	ADMIXTURE

METHOD OF CURING

☐ IN SATURATED STEAM, AT _____ °F, AND _____ PSI GAGE, FOR _____ HOURS

☐ NOT IN STEAM *(Describe)* _____

METHOD OF DRYING

☐ IN OUTSIDE AIR ☐ UNDER ROOF FOR _____ DAYS

☐ IN DRYING KILN FOR _____ HOURS AT _____ °F

☐ QUICK PRESSURE RELEASE IN AUTOCLAVE ☐ WITH VACUUM

BEFORE BREAKING, BLOCK APPEARS

☐ DRY ☐ DAMP

ABSORPTION AND MOISTURE TEST (ASTM C-140)

	A	B	C	D
BLOCK 1				
BLOCK 2				
BLOCK 3				

A – SAMPLED WEIGHT OF UNIT IN POUNDS
B – WET WEIGHT OF UNIT IN POUNDS
C – SUSPENDED IMMERSED WEIGHT OF UNIT IN POUNDS
D – DRY WEIGHT OF UNIT IN POUNDS

	1	2	3
ABSORPTION LB/CU FT = $\frac{B-D}{B-C}$ X 62.4			
MOISTURE CONTENT % OF TOTAL ABSORPTION = $\frac{A-D}{B-D}$ X 100			
UNIT WEIGHT LB/CU FT = $\frac{D}{B-C}$ X 62.4			

AVERAGE ANNUAL RELATIVE HUMIDITY

MOISTURE CONTENT, MAXIMUM % OF TOTAL ABSORPTION (AVG ANNUAL R.H.) (ASTM C-90)

LINEAR SHRINKAGE AS FOUND	75+	75 TO 50	50-
0.03 OR LESS	45	40	35
0.03 TO 0.045	40	35	30
0.045 OR OVER	35	30	25

MOISTURE CONDITION TEST (ASTM C-427)

TEST STARTED AT _____ HR. _____ MIN.

AVG REL HUMIDITY OF MONTH OF DELIVERY _____

TIME *(Mins)*	RELATIVE HUMIDITY INDICATED %	RELATIVE HUMIDITY ACTUAL %	TEMPERATURE IN CONT. °F	TEMPERATURE IN ROOM °F
0				
5				
10				
15				
20				
25				
30				
35				
40				
45				
50				
55				
60				
65				
70				
75				
80				
85				
90				

RESULTS

FINAL ACTUAL *(CORRECTED)* REL. HUM. _____

FINAL TEMPERATURE IN CONTAINER IS _____

Values at zero time are the relative humidity and temperature of room air indicated by the hygrometer and thermometer in the cover just before it was placed in the container.

CESPK FORM 181
1 AUG 88

(Edition of 1 Jun 77 will be used)